
Keysight M8197A

Synchronization module for M8195A

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All front-panel connectors of the M8195A are sensitive to Electrostatic discharge (ESD). We recommend to operate the instrument in an electrostatic safe environment.

There is a risk of instrument malfunction when touching a connector.

Please follow this instruction:

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Safety Information

CAUTION

A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

WARNING

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Safety Summary

General Safety Precautions	<p>The following general safety precautions must be observed during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. For safe operation the general safety precautions for the M9502A and M9505A AXIe chassis, must be followed. See: http://www.keysight.com/find/M9505A Keysight Technologies Inc. assumes no liability for the customer's failure to comply with these requirements. Before operation, review the instrument and manual for safety markings and instructions. You must follow these to ensure safe operation and to maintain the instrument in safe condition.</p>
Initial Inspection	<p>Inspect the shipping container for damage. If there is damage to the container or cushioning, keep them until you have checked the contents of the shipment for completeness and verified the instrument both mechanically and electrically. The Performance Tests give procedures for checking the operation of the instrument. If the contents are incomplete, mechanical damage or defect is apparent, or if an instrument does not pass the operator's checks, notify the nearest Keysight Technologies Sales/Service Office.</p> <p>WARNING To avoid hazardous electrical shock, do not perform electrical tests when there are signs of shipping damage to any portion of the outer enclosure (covers, panels, etc.).</p>
General	<p>This product is a Safety Class 3 instrument. The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.</p>
Environment Conditions	<p>This instrument is intended for indoor use in an installation category II, pollution degree 2 environment. It is designed to operate within a temperature range of 0 °C – 40 °C (32 °F – 105 °F) at a maximum relative humidity of 80% and at altitudes of up to 2000 meters.</p> <p>This module can be stored or shipped at temperatures between -40 °C and +70 °C. Protect the module from temperature extremes that may cause condensation within it.</p>
Before Applying Power	<p>Verify that all safety precautions are taken including those defined for the mainframe.</p>
Line Power Requirements	<p>The Keysight M8197A operates when installed in an Keysight AXIe mainframe.</p>
Do Not Operate in an Explosive Atmosphere	<p>Do not operate the instrument in the presence of flammable gases or fumes.</p>
Do Not Remove the Instrument Cover	<p>Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made only by qualified personnel. Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.</p>

Safety Symbols

Table 1 Safety Symbol

Symbol	Description
	Indicates warning or caution. If you see this symbol on a product, you must refer to the manuals for specific Warning or Caution information to avoid personal injury or damage to the product.
	C-Tick Conformity Mark of the Australian ACA for EMC compliance.
	CE Marking to state compliance within the European Community: This product is in conformity with the relevant European Directives.
	General Recycling Mark

Table 2 Compliance and Environmental Information

Symbol	Description
	This product complies with the WEEE Directive (2002/96/EC) marketing requirements. The affixed label indicates that you must not discard this electrical/electronic product in domestic household waste. Product category: With reference to the equipment types in the WEEE Directive Annexure I, this product is classed as a "Monitoring and Control instrumentation" product.
	Do not dispose in domestic household waste.
	To return unwanted products, contact your local Keysight office, or see http://about.keysight.com/en/companyinfo/environment/takeback.shtml for more information.

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1 Introduction

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Introduction

This chapter provides an overview of Keysight M8197A module.

The M8197A synchronization module is used together with 1 to 4 M8195A modules to build a fully synchronous, phase coherent multi-channel generator system with up to 16 analog channels.

When running in synchronous mode, all of the M8195A modules work with the same sample clock and start at the same time. The common system clock (Sys Clk) is derived either from the M8197A's internal clock synthesizer or from an external sample clock that is connected to the M8197A's reference clock input (REF CLK IN).

The skew between any two channels is guaranteed to be within +/- 75 ps (without system level calibration) independent of the sample rate. Using the fine delay adjust capability of the M8195A with 50 fs resolution, the skew can be adjust to less than 1 ps between any two channels. Once adjusted, the skew is maintained across loading new waveforms, changing sample rate and power cycles to better than 1 ps.

A common trigger input is available on the synchronization module to trigger all the connected M8195A modules simultaneously with deterministic latency. Triggered waveforms have the same inter-channel skew as continuous waveforms. To achieve the lowest possible trigger delay uncertainty, the trigger input can be synchronized externally to the REF CLK output.

Features and Benefits

M8197A provides following features and benefits:

- Synchronization of up to 4 M8195A modules (= 16 channels)
- One trigger input can trigger up to 4 M8195A modules with deterministic latency
- Skew repeatability of 1 ps between any two channels – independent of sample rate
- Skew resolution of 50 fs between any two M8195A of the synchronous system
- 1U AXIe module for high port density

Additional Documents

Additional documentation can be found at:

- <http://www.keysight.com/find/M9505A> for 5-slot chassis related documentation.
- <http://www.keysight.com/find/M9502A> for 2-slot chassis related documentation.
- <http://www.keysight.com/find/M9048A> for PCIe desktop adapter card related documentation.
- <http://www.keysight.com/find/M9536A> for embedded AXIe controller related documentation.
- <http://www.keysight.com/find/M8195A> for AXIe based AWG module related documentation.

1.1 Document History

First Edition (November 2015)	The first edition of the user guide describes the functionality of firmware version 2.5.
Second Edition (April 2016)	The second edition of the user guide describes the functionality of firmware version 3.0.
Third Edition (July 2016)	The third edition of the user guide describes the functionality of firmware version 3.1.
Fourth Edition (March 2019)	The fourth edition of the user guide describes the functionality of firmware version 4.0.

1.2 Accessories

The M8197A is always delivered with four Sys clock cables. The Sys Clock cables are matched pair cables. It is mandatory to use exactly the provided cables. Otherwise the synchronous system will not operate as specified. To avoid using non-specified cables, the Sys Clock cables are equipped with QMA to SMA connectors.

1.3 M8197A Front Panel

The following figure shows the front panel of the M8197A module:



Figure 1 Front Panel of M8197A

Inputs/Outputs

The inputs and outputs available on the front panel of the M8197A module are described in [Table 3](#).

Table 3 Inputs and Outputs available on the front panel of the M8197A module

Input/Outputs	Description	Connector Type
DYNAMIC CONTROL IN / OUT	Configured as parallel Input port: Used to control sequencing of the synchronous system by external signals. This input is defined in detail in the chapter Sequencing of the User's Guide of the M8195 Configured as parallel Output port: General purpose parallel digital I/O.	Proprietary parallel connector
SYS CLK OUT	Connect to Trig In of each M8195A that is part of the synchronous system	QMA
TRIG IN	The Trigger Input has a combined functionality as Trigger or Gate and is used to start the synchronous system by an external signal. This input is defined in detail in the chapter Sequencing of the User's Guide of the M8195	SMA
EVENT IN	The Event Input (EVENT IN) is used to e.g. step through segments or scenarios by an external signals. This input is defined in detail in the chapter Sequencing of the User's Guide of the M8195.	SMA
REF CLK IN	The Reference Clock Input can be used to synchronize to an external clock. The input frequency can vary between 10MHz and 17 GHz.	SMA
REF CLK OUT	The Reference Clock Output can be used to synchronize a DUT to the M8197A and thus to the synchronous system. The adjustable output frequency covers a large frequency range.	SMA

1.3.1 Front Panel LED

1.3.1.1 Status LED

Two LEDs are available at the front panel to indicate the status of the M8197A module:

The green **"Access"** LED indicates that the controlling PC exchanges data with the M8197A module.

The red **"Fail"** LED has following functionality:

- It is "ON" for about 30 seconds after powering the AXIe chassis.
- After about 30 seconds, the LED is switched "OFF". If an external PC is used to control the AXIe chassis, this PC can be powered after this LED has switched OFF.
- During normal operation of the module this LED is "OFF". In case of an error condition e.g. a self-test error, the LED is switch "ON".
- In case the output relay has shut-off because of an external overload condition, this LED flashes.

1.3.1.2 Trigger IN and Event IN LED

This LED indicates that an externally applied signal matches the adjusted threshold to be used as a Trigger or Event. The LED turns on for ~100 ms for each detected edge of the correct polarity i.e. a rising edge turns the LED on for 100 ms if the polarity is adjusted to rising. If the polarity is adjusted to rising, and a falling edge is externally applied, the LED remains OFF.

Notes:

- In case the edges are applied faster than every 100 ms, the LED is continuously ON.
- In trigger mode 'Gated', the LED is turned on for 100 ms when the gate signal becomes active i.e. when the polarity is set to positive, the LED turns on for 100 ms after the rising edge. When the polarity is set to negative, the LED turns on for 100 ms after the falling edge.
- In trigger mode 'Gated', the polarity cannot be set to 'Either'

Table 4: Trigger IN and Event IN LED

Color	Meaning	Description
Off	No external Trigger (Event)	In case the trigger source is not set to external, this LED is OFF.
ON, green	Valid external Trigger (Event) detected	In case the trigger mode is set to 'asynchronous', a Trigger (Event) is always valid. Set-up or hold time violations do not exist. Note: A 'Force Trigger' from the SFP or SCPI does not turn the LED ON
ON, red	Invalid external Trigger (Event) detected	In case the trigger mode is set to 'synchronous', a Trigger (Event) can be invalid because of a set-up or hold time violation. The LED turns On red in case a set-up or a hold time violation has been detected. Note A 'Force Trigger' from the SFP or SCPI does not turn the LED ON

1.3.1.3 Ref CLK IN LED

Table 5: Ref CLK IN LED

Color	Meaning	Description
Off	Applied clock cannot be used	In case the clock reference is not set to Ref CLK IN, this LED is OFF.
ON, green	Valid signal at Ref CLK IN detected	<ul style="list-style-type: none"> • CDR has locked on Ref CLK In and • The externally applied frequency is correct and • Ref CLK In has been selected as the clock reference
ON, red	No valid signal at Ref CLK IN	<ul style="list-style-type: none"> • Ref CLK In has been selected as the clock reference • The externally applied clock signal is not valid. E.g. the frequency does not match the adjusted value or the amplitude is outside the specified range

2 M8197A Installation

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2.1 Introduction

This chapter explains the steps required to install M8197A module.

2.1.1 Pre-Requisites

The following are the pre-requisites for installing Keysight M8197A software:

- The supported operating systems are:
 - Windows 10 (32 bit or 64 bit)
- Ensure that you have Keysight IO Libraries Suite 2017 Update 1 or later installed on your system. The Keysight IO Libraries Suite can be found on the CD that is part of shipment content or at <http://www.Keysight.com/find/iosuite>.

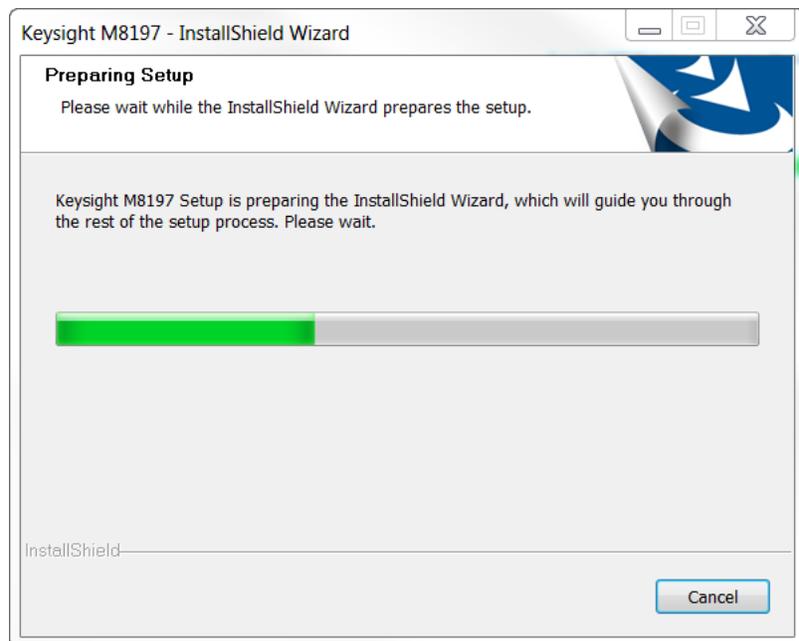
2.1.2 Installation Process

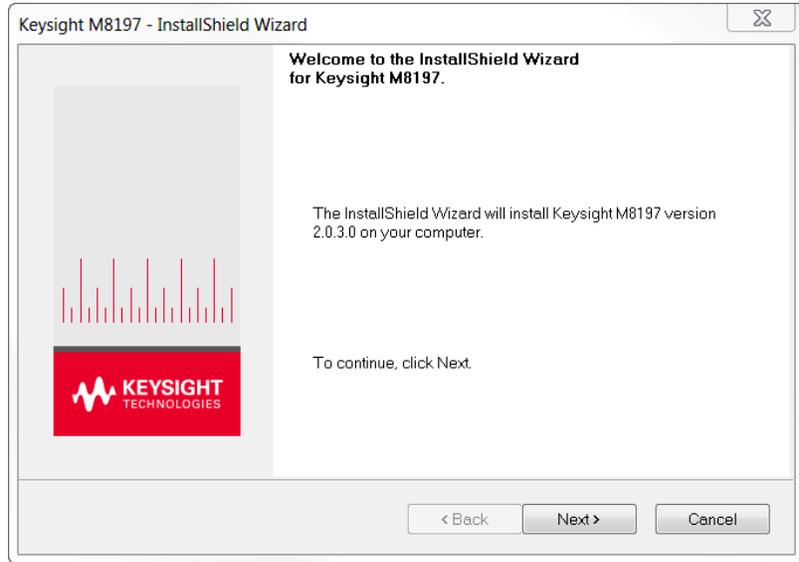
Follow the given steps to install **Keysight M8197A** software on your system:

1. Double-click the executable (**M8197_Setup.exe**). This executable file is available either on CD or Web.

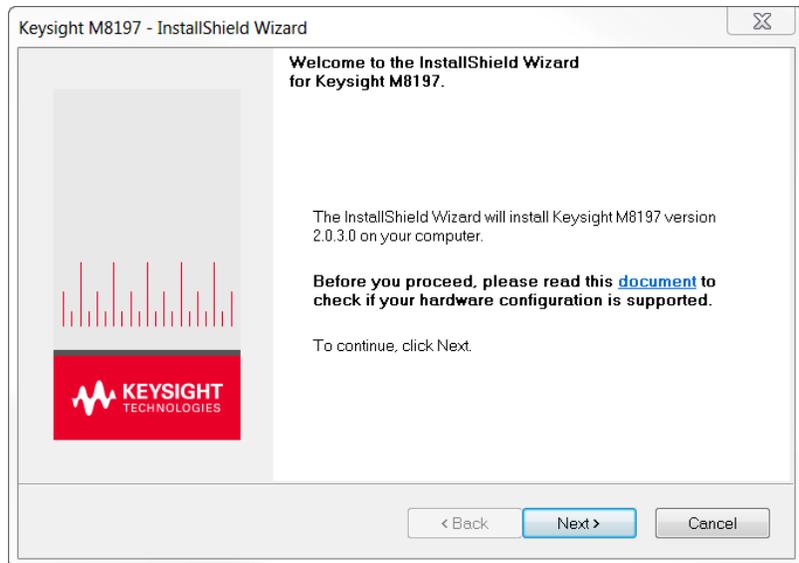


2. The Keysight **M8197A Setup** will prepare the **InstallShield Wizard** for the installation process. The following windows will appear.

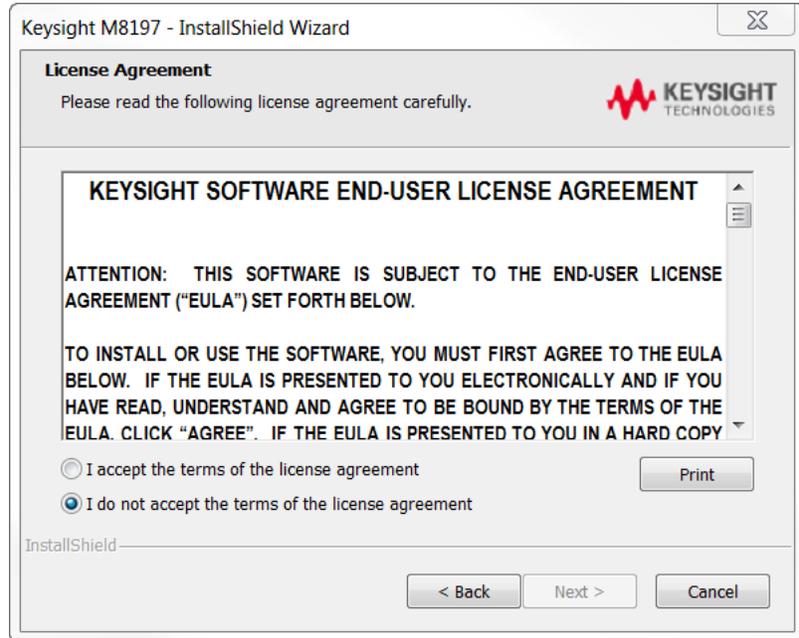




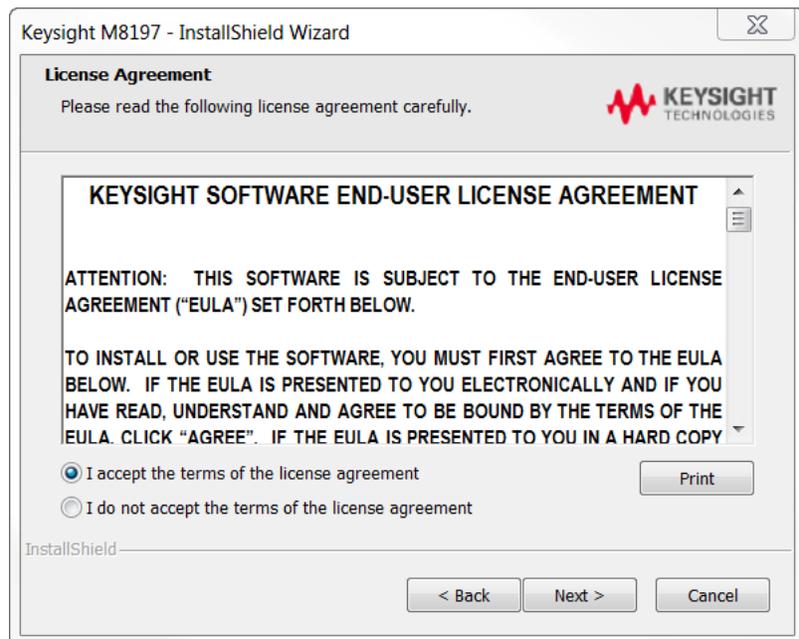
3. Click **Next**.



4. We recommend you to read the document to check if your hardware configuration is supported.
Click **Next** to proceed to the license agreements.



5. Accept the terms of 'Keysight Software End-User License Agreement'.



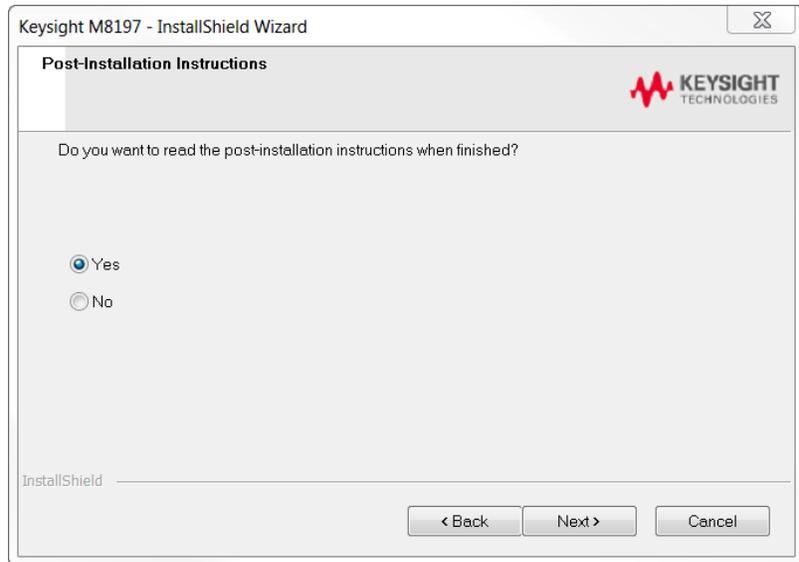
6. Click **Next**.



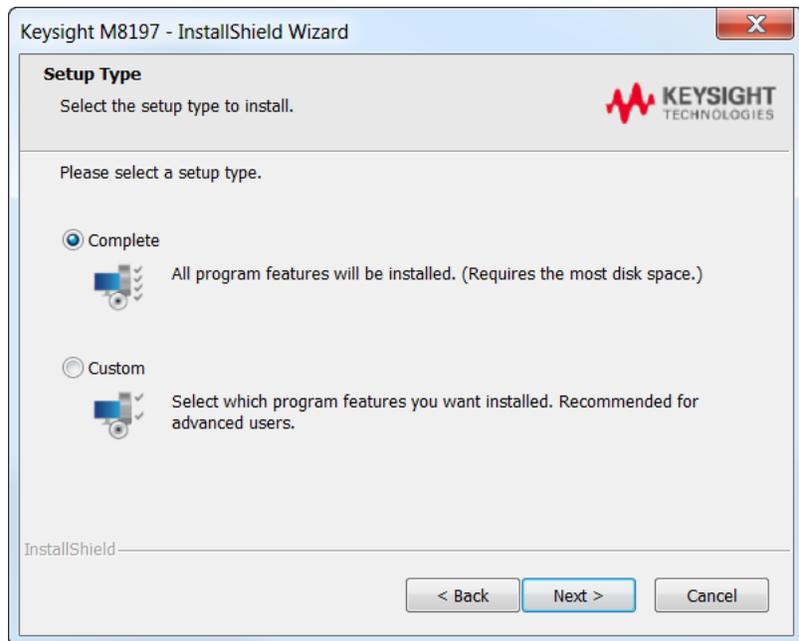
- 7. Accept the 'Keysight IVI Driver Source Code License Agreement Terms'.



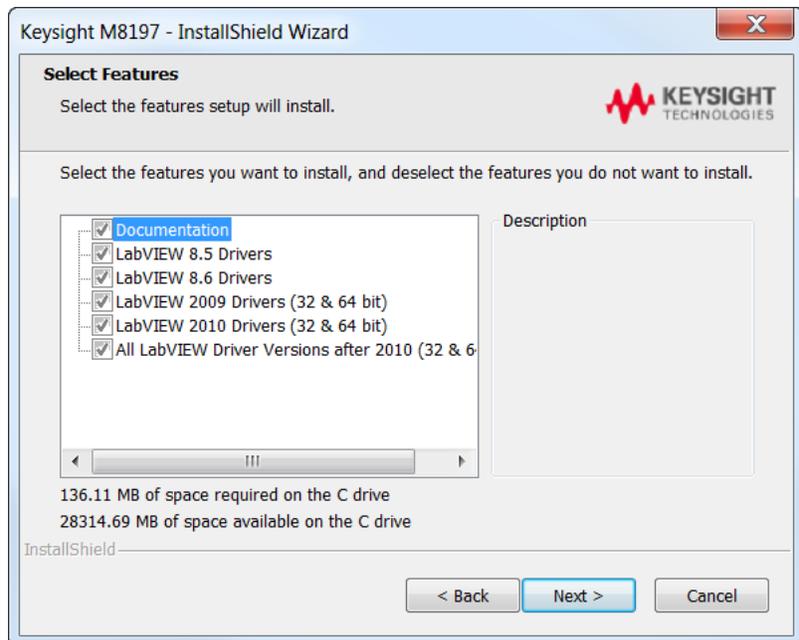
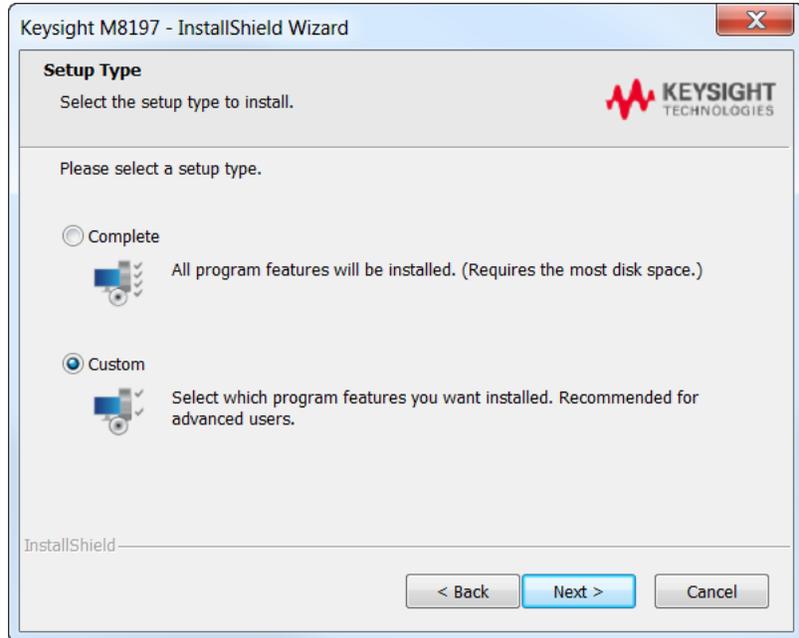
- 8. Click Next.



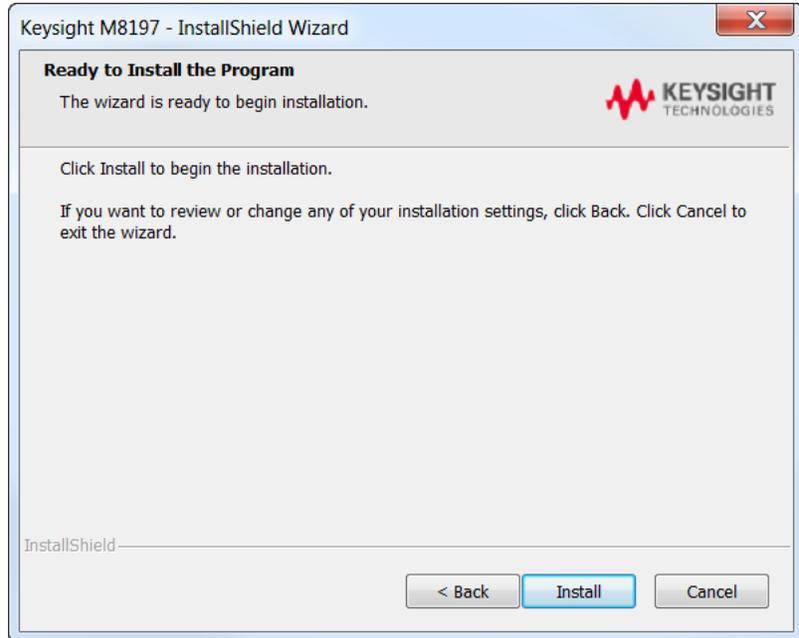
9. Select **Yes** if you want to read the post-installation instructions. Click **Next** to select setup type.



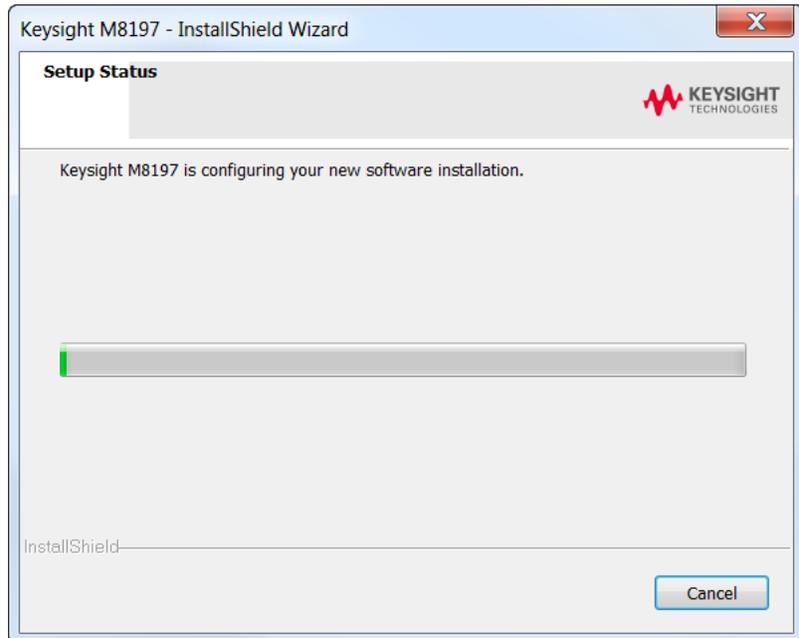
10. Select a setup type either **Complete** or **Custom**. If you select **Custom**, you can specify which optional features will be installed.



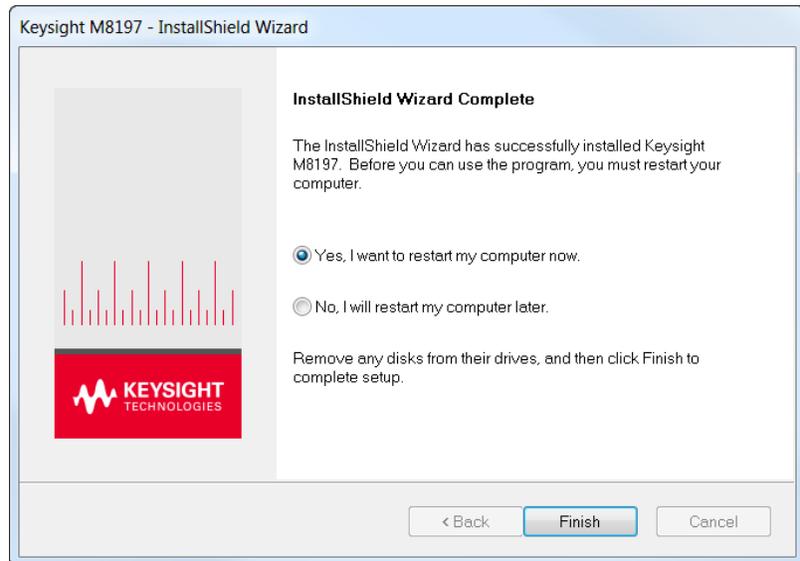
11. Click **Next**.



12. Click **Install** to begin the installation. The **Setup Wizard** will now install M8197A.



13. The following screen will appear once the **Keysight M8197A** software is successfully installed on your system.



14. Click **Finish** to restart your system.

This completes the Keysight M8197A software installation.

2.1.3 Post Installation Steps

NOTE

If M8197A is already powered up and connected to PC using the PCIe, just reboot the PC, and start with step 5. No such reboot step is required in case of a USB connection.

Follow the post installation steps as shown below:

1. Shut down PC and instrument.
2. Connect the instrument to the PC using a PCIe or USB cable.
3. Switch on instrument. Wait until the “Access” LED of the M8197A has switched from red to green.
4. Switch on PC.
5. The PC should automatically recognize the instrument.
6. Check this in the device manager; e.g. via **Start > Control Panel > Device Manager**, or right-click **Computer > Manage > Device Manager**:

In case of PCIe:

7. The instrument should be visible in the device tree as **Keysight Technologies Modular Devices > M8197A**

In case of USB:

8. The instrument should be visible in the device tree as **Keysight Modular Platform (AMP/AXIe) > Keysight Technologies USB AMP/AXIe Chassis**.

NOTE

In case of PCIe, post installation steps must be followed strictly in the same order as mentioned for successful connection of the PC with M8197A. However, in case of USB no such restriction is applicable i.e. the PC can be powered before the M8197 is turned ON.

NOTE

Your PC might request a reboot. Reboot your PC, if requested.

9. (PCIe only) Check if the M8197 is also visible in the Keysight Connection Expert:
e.g. via **Start > All Programs > Keysight Connection Expert**.
10. If something went wrong and the Instrument is not shown in the PXI section, it may be necessary to reboot the PC once more.
11. Install Intel Network Drivers on Windows XP: The AXIe chassis contains an Intel 82573L NIC as a PCIe endpoint. Refer to the AXIe chassis User's Guide at <http://www.Keysight.com/find/M9505A> for instructions how to install this driver.

2.1.4 How to Control the Instrument

1. If you use a PCIe link to control the M8197A, the AXIe chassis must be switched-on before you start the PC. If you use a USB link to control the M8197A, it's not mandatory that the AXIe chassis is powered and has booted prior to turning on the PC.
2. Start the M8197A Soft Front Panel (**Start > All Programs > Keysight M8197 > Keysight M8197 Soft Front Panel**). The user interface will display the VISA resource strings for different kinds of connection.
3. Using the appropriate VISA resource string you can:
 - Start the Soft Front Panel (**Start > All Programs > Keysight M8197 > Keysight M8197 Soft Front Panel**).
 - Control the instrument with your own application using the M8197 IVI Drivers or add it as a LAN instrument in the Keysight Connection Expert (TCPIP0::localhost::...) and control it using SCPI (with e.g. the VISA Assistant or your own application).
4. You must start the M8197A Soft Front Panel in order to send SCPI commands to the instrument.

NOTE

The M8197 IVI Drivers start the M8197A Soft Front Panel automatically.

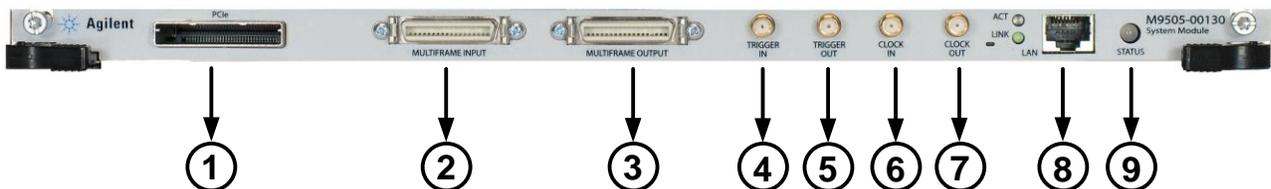
2.2 AXI Chassis

The detailed documentation for the AXIe chassis can be found at:

- <http://www.Keysight.com/find/M9505A> for 5-slot chassis
- <http://www.Keysight.com/find/M9502A> for 2-slot chassis.

2.2.1 ESM Front Panel Connector

The ESM Front Panel Connector is shown in the figure below:



1	PCIe	Connects a host PC to the chassis via PCIe. PCIe is the only interface that can be used to control the M8197A module.
2	Multiframe Input	Synchronizes timing signals with multiple daisy-chained chassis. These signals are not needed to synchronize M8190A modules. The M8197A synchronization module is needed instead.
3	Multiframe Output	
4	Trigger In	External Trigger connections.
5	Trigger Out	The Trigger In of the AXle ESM cannot be used to trigger the M8197A. The M8197A has its own Trigger In. The Trigger Out of the AXle ESM cannot be controlled by the M8197A.
6	Clock In	External clock connections.
7	Clock Out	
8	LAN	Connects the host PC to the chassis, via 10/100/1000 Ethernet. In particular, the LAN connector is used for ESM configuration, but NOT to communicate to the M8197A.
9	Status Light	Indicates the chassis status.

3 System Configuration

- 3.1 Introduction / 30
- 3.2 Supported AXle Frame Combinations / 32
- 3.3 Controlling One AXle Chassis / 33
- 3.4 Synchronous System Cabling / 35
- 3.5 Controlling the Synchronous System / 36

3.1 Introduction

This chapter describes how to configure a synchronous system. The term ‘synchronous system’ describes multiple M8195A AWG modules that operate entirely synchronous with respect to timing parameters including synchronous start, synchronous sequencing, common trigger and common sample clock. A synchronous system consists of:

- One M8197A synchronization module
- One or up to four M8195A AWG slave modules
- One M9502A 2-slot AXIe chassis or one M9505A 5-slot AXIe chassis
- An external PC to control the synchronous system
- One clock cable M8197-61601 for each synchronized M8195A AWG slave module
- M8197A software that controls the synchronous operation of the system
- M8195A software that controls the operation of the M8195A AWG modules

NOTE

There are some generic rules to be considered for the configuration of a synchronous system. The M8197A synchronization module must always be inserted in the lowest slot number of the synchronous system. The M8197A and M8195A modules of the synchronous system must be inserted in ascending slot numbers without leaving a slot empty. In case a M9536A system controller module is used, the controller module must be inserted in slot 1.

The M8197A synchronization module is designed to synchronize up to four M8195A arbitrary waveform generator modules. The M8195A modules have to be located in the same AXIe chassis as the M8197A in direct order above the M8197A.

A synchronous trigger signal to start the system synchronously is distributed via the AXIe chassis backplane and a system clock signal is distributed using the clock cables M8197-61601. These clock cables are connected on the front panel between the M8197A synchronization module and the M8195A arbitrary waveform generator modules.

All synchronous system configurations require an external desktop PC or laptop PC with PCIe interface cable connection or USB cable connection to control the system. As alternative to an external PC, a M9536A system controller module can be used to control the system.

Any number of up to 16 Arbitrary Waveform Generator channels can be configured using a combination of 1-channel, 2-channel and 4-channel M8195A Arbitrary Waveform Generators (see section 3.2). Typical multi-channel configurations are described in the following subchapters:

3.1.1 Up to 4 M8195A AWG Channels in an M9502A 2-Slot Chassis

To configure a synchronous system with up to 4 AWG-channels including high resolution triggering and dynamic sequence control, use one 2-slot AXIe chassis M9502A, one M8197A synchronization module, and one M8195A 4-channel Arbitrary Waveform Generator module.

- The M8197A synchronization module must be inserted in slot 1,
- The M8195A AWG module must be inserted in slot 2.

3.1.2 Up to 16 M8195A AWG Channels in an M9505A 5-Slot Chassis

To configure a synchronous system with up to 16 AWG-channels including high resolution triggering and dynamic sequence control, use one 5-slot AXIe chassis M9505A, one M8197A synchronization module, and up to four M8195A 4-channel Arbitrary Waveform Generator modules.

- The M8197A synchronization module must always be inserted in the lowest slot number of the synchronous system.
- The M8197A and M8195A modules of the synchronous system must be inserted in ascending slot numbers without leaving a slot empty.
- In case a M9536A system controller module is used, the controller module must be inserted in slot 1.

Multiple (maximum two) synchronous systems can be built in one 5-slot chassis.

3.1.3 Up to 16 M8195A AWG Channels in an M9514A 14-Slot Chassis

To configure a synchronous system with up to 16 AWG-channels including high resolution triggering and dynamic sequence control, use one 14-slot AXIe chassis M9514A, one M8197A synchronization module, and up to four M8195A 4-channel Arbitrary Waveform Generator modules.

- The M8197A synchronization module must always be inserted in the lowest slot number of the synchronous system.
- The M8197A and M8195A modules of the synchronous system must be inserted in ascending slot numbers without leaving a slot empty.
- A synchronous system must be either completely inserted left (slot 1s ..6) or right (slots 8 ...14) from the AXIe System Module (ASM).
- In case a M9536A system controller module is used, the controller module must be inserted in slot 1.

Multiple (maximum five) synchronous systems can be built in a 14-slot chassis.

3.2 Supported AXle Frame Combinations

Besides the typical and most common synchronous system configurations described in chapter 3.1 the synchronous system configuration is not limited to these example.

Table 6 Valid Synchronous System Configurations

Number of M8197A	Number of M8195A	Supported AXle Chassis Combinations
1	1	One M9502A 2-slot AXle chassis
1	2	One M9505A 5-slot AXle chassis
1	3	One M9505A 5-slot AXle chassis
1	4	One M9505A 5-slot AXle chassis

3.3 Controlling One AXIe Chassis

The basic configuration of a synchronous system with sixteen synchronous M8195A AWG channels is shown in [Figure 2](#):

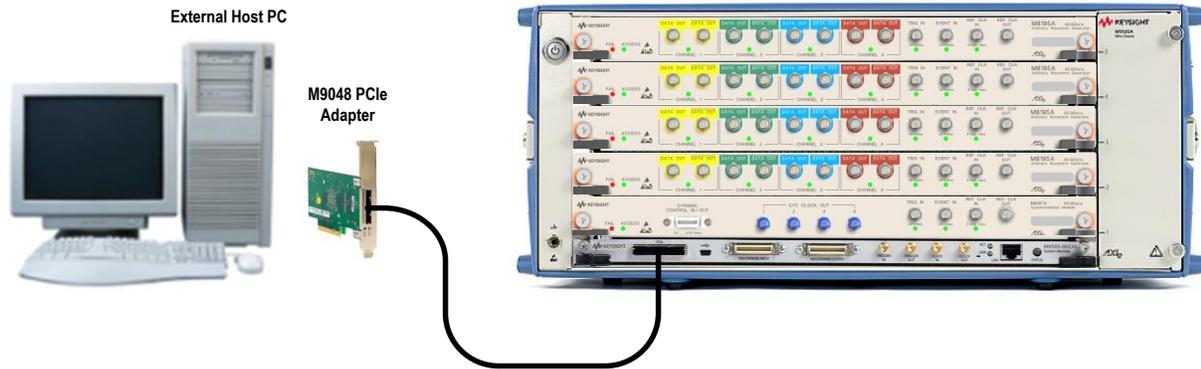


Figure 2 One AXIe chassis connected to an external host PC

A synchronous system with sixteen synchronous M8195A AWG channels consists of:

- Four M8195A 4-channel arbitrary waveform generator modules
- One M8197A synchronization module. The delivery content of the M8197A synchronization module includes:
 - Four clock cables with a QMA connector at one end and a SMA connector at the other end. See [Figure 3](#).
- One M9505A 5-Slot AXIe chassis
- External controlling PC including PCIe IF card and PCIe cable or USB cable



Figure 3 M8197-61601 QMA to SMA clock cable

3.4 Synchronous System Cabling

This section describes the cable connections of a sixteen channel synchronous system. A sixteen channel synchronous system consists of:

- Four M8195A 4-channel arbitrary waveform generator modules
- One M8197A synchronization module. The delivery content of the M8197A synchronization module includes:
 - Four clock cables with a QMA connector at one end and a SMA connector at the other end.
- One M9505A AXIe chassis
- External controlling PC including PCIe IF card and PCIe cable or USB cable

Figure 4 depicts the sixteen channel synchronous system cabling.

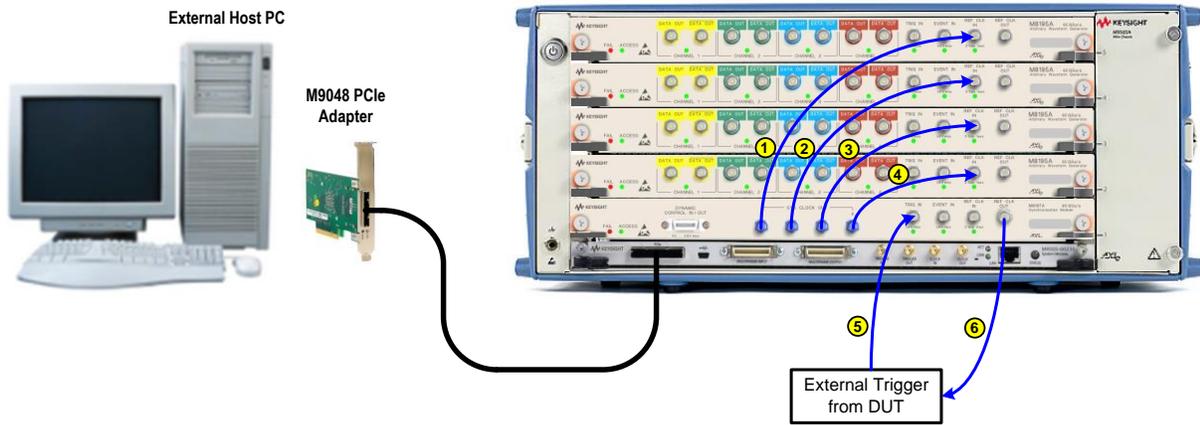


Figure 4 System level cabling of a sixteen channel synchronous system

The highlighted cables in the synchronous system cabling are described in Table 7.

Table 7 Cable Connections

Cable No.	Cable Type	Source	Destination
1 - 4	QMA to SMA	Sync module: SYS CLK OUT	AWG slave modules: REF CLK IN
5	SMA to SMA	Sync module: REF CLK OUT	Device Under Test (DUT) Clock Input
6	SMA to SMA	Device Under Test (DUT) Trigger Output	Sync module: TRIG IN

3.5 Controlling the Synchronous System

This section describes the ways to control the synchronous system.

3.5.1 Requirements for Controlling the Synchronous System

The requirements for controlling the synchronous system are as follows:

- Any remotely controlled M8195A module that will become part of the synchronous system must be made visible in KCE (Keysight Connection Expert)
- The M8195A firmware of each module of the synchronous system must be started prior to configuring the synchronous system.
- SYS CLK outputs of the M8197A may be used in any order. Example: For four M8195A modules, SYSCLK OUT 1, SYSCLK OUT 2, SYSCLK OUT 3 and SYSCLK OUT 4 must be connected.

3.5.2 Synchronous System Operation Modes

The synchronous system has the following two modes of operation:

1. Configuration mode
2. Operation mode

3.5.2.1 Configuration Mode

The configuration mode is used while connecting external cables of the synchronous system or during configuration of main parameters such as setting the common sample clock frequency that affects the entire synchronous system. Specifically when defining which M8195A found by Keysight Connection Expert (KCE) modules belong to the synchronous system or when system parameters (see section 3.5.3.2) are being changed, the system must be stopped and set in configuration mode:

3.5.2.2 Operation Mode

The operation mode is used for data generation and to synchronously start the system. To start data generation you must switch to operation mode.

Whenever the user switches from configuration mode to operation mode, following system checks and actions are performed:

- Verify that the firmware version of all M8195A AWG modules and the M8197A synchronization module of the synchronous system is identical and higher than V2.5.0 .
Verify that each M8195A of the synchronous system has a common set of options.
 - a. M8195A Rev.1 modules must not be part of synchronous system.
 - b. In case all M8195A modules have installed the Fast Switching Mode option –FSM, the system will operate in fast switching mode. In case one or more M8195A modules of the synchronous system do not have the option –FSM installed, the M8197A module and thus the entire synchronous system behaves as not having the option –FSM installed.
- Verify that each M8195A of the synchronous system operates with a valid system clock. Thus correct cabling of the system clock cables is checked.
- Verify that a trigger propagates from the M8197A synchronization module to each M8195A module of the synchronous system. Thus correct trigger distribution via backplane communication is checked.
- Transfer the settings of sample frequency to the M8195A modules of the synchronous system.
- Perform accurate delay alignment among all M8195A channel in the synchronous system.

3.5.3 Control Parameters

In a synchronous system, many parameters such as the common sample clock frequency cannot be adjusted individually on each M8195A AWG module. Otherwise, synchronous operation would not be possible. This section describes how to control parameters that affect the entire synchronous system. This section describes as well whether a specific system parameter is controlled by the M8197A or the M8195A.

3.5.3.1 Using M8197A Soft Front Panel

The Soft Front Panel of the M8197A lists all M8195A that are available in the local PC or in KCE in a table. Using this table the user can define that a certain M8195A will be,

- Part of the synchronous system marked as 'Slave'
- Or will not be part of the synchronous system marked as 'None'

Following parameters can be controlled using the M8197A Soft Front Panel:

- Sample frequency
- Trigger mode ('Continuous', 'Triggered' or 'Gated')
- Arm mode ('Self' or 'Armed')
- Trigger threshold
- Trigger polarity ('Positive', 'Negative' or 'Either')
- Trigger and Event operation ('Synchronous' or 'Asynchronous')
- Event threshold
- Event polarity ('Positive', 'Negative' or 'Either')
- Internal trigger frequency
- Mapping of Trigger In, Event In and Internal Trigger to 'Trigger/Gate', 'Advance Event' and 'Enable Event'
- Enable or Disable of 'Trigger/Gate', 'Advance Event' and 'Enable Event'
- Single trigger actions 'Force Trigger', 'Force Gate', 'Force Event' or 'Force Enable'
- Synchronous start and stop of all M8195A modules in the system by software

3.5.3.2 Using M8195A Soft Front Panel

The following parameters in the Clock tab menu are disabled in the M8195A slave modules:

- DAC Sample Frequency
- Sample Clock Source (AXIe Backplane, Reference Clock In, Internal)
- Reference Clock Frequency Range

All parameters in the Trigger tab menu are disabled in the M8195A slave modules, only the 'Force Trigger'-, 'Force Gate'-, 'Force Event' - and 'Force Enable' -push buttons are enabled for debugging purposes.

To modify all the above named, disabled parameters you need to switch to configuration mode first and remove the M8195A slave modules from the synchronous system by setting them from 'Slave' - to 'None' - mode.

Table 8 lists the common synchronous system parameters that can be controlled by the M8197A or M8195A.

Table 8 Parameters controlled from M8197A and M8195A

Functionality	M8197A Synchronization Module	M8195A Slave Module
Sample frequency	Controls all M8195A Slave Modules. Modification is only possible in configuration mode	Disabled
Arm mode	Controls all M8195A Slave Modules. All M8195A operate in the same arm mode ('Self' or 'Armed'). Modification is only possible in configuration mode	Disabled
Trigger mode	Controls all M8195A Slave Modules. All M8195A operate in the same trigger mode ('Continuous', 'Triggered' or 'Gated'). Modification is only possible in configuration mode	Disabled
Trigger In Threshold	Affects all M8195A Slave Modules	Disabled
Trigger In Polarity	Affects all M8195A Slave Modules	Disabled
Trigger In and Event In Operation	Affects all M8195A Slave Modules. Modification is only possible in configuration mode	Disabled
Internal Trigger Frequency	Controls all M8195A Slave Modules. Modification is only possible in configuration mode	Disabled
Event Threshold	Affects all M8195A Slave Modules	Disabled
Event Polarity	Affects all M8195A Slave Modules	Disabled
Force Trigger / Gate	Affects all M8195A Slave Modules	Locally available for debugging
Force Enable	Affects all M8195A Slave Modules	Locally available for debugging
Force Event	Affects all M8195A Slave Modules	Locally available for debugging
Mapping of Trigger In, Event In and Internal Trigger to 'Trigger/Gate', 'Advance Event' and 'Enable Event'	Controls all M8195A Slave Modules.	Disabled
Run/Stop	Controls all M8195A Slave Modules.	Disabled

4 M8197A Soft Front Panel

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4.1 Introduction

This chapter describes the M8197A Soft Front Panel (SFP).

4.2 Launching the M8197A Soft Front Panel

From the Start menu, select **All Programs > Keysight M8197 > Keysight M8197 Soft Front Panel**.

NOTE

To control the instrument through SCPI:
From the **Keysight Connection Expert**, select the discovered M8197 module, click **“Send Commands To This Instrument”**.

The following screen will appear:

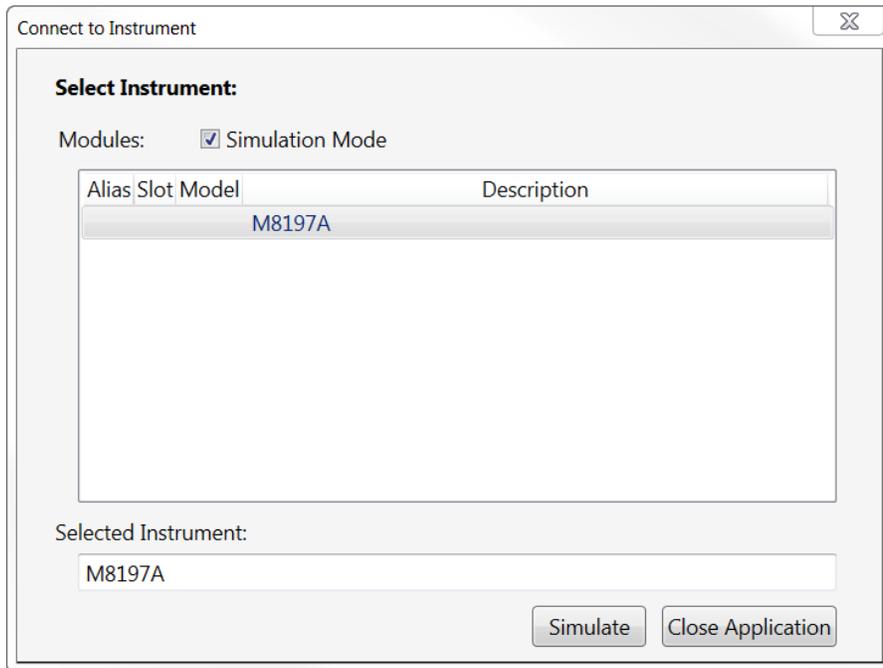


Figure 5 M8197A connected to PC

The instrument selection dialog shows the addresses of the discovered M8197A modules. Select a module from the list and press “Connect”.

If no M8197A module is connected to your PC, you can check “Simulation Mode” to simulate an M8197A module.

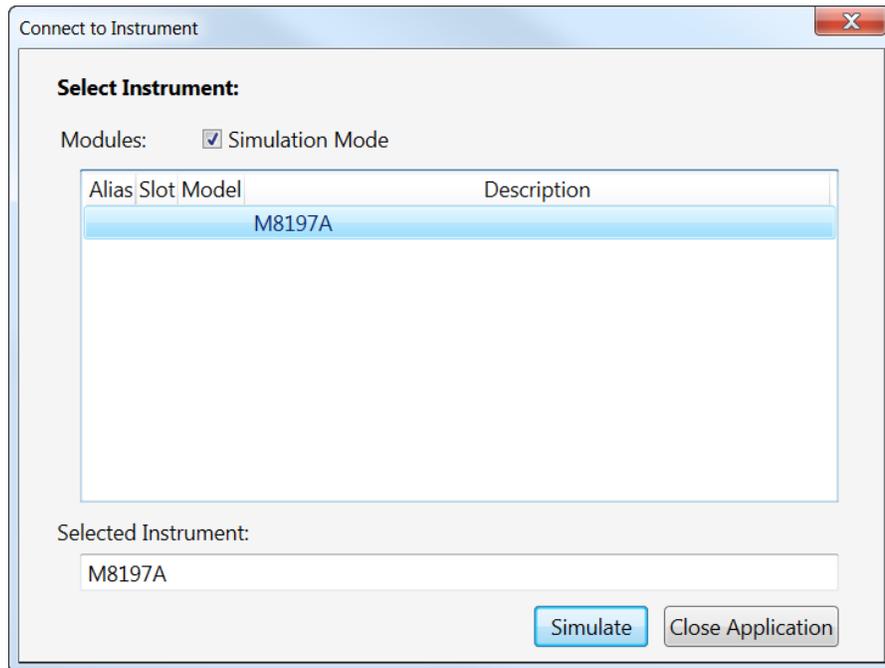


Figure 6 M8197A connected in simulation mode

4.3 M8197A Soft Front Panel

The M8197A Soft Front Panel allows you to:

- Configure a multi-module group,
- Control the M8197 trigger input parameters,
- Synchronously start all channels of the multi-module group.

It includes the following GUI items:

- Title Bar
- Menu Bar
- Status Bar
- Tabs (Module, Clock, Trigger, and Dynamic Control)

The detailed information on these GUI items is described in the sections that follow.

4.3.1 Title Bar

The title bar contains the standard Microsoft Windows elements such as the window title and the icons for minimizing, maximizing, or closing the window.

4.3.2 Menu Bar

The menu bar consists of various pull down menus that provide access to the different functions and launch interactive GUI tools.

The menu bar includes the following pull down menu:

- File
- View
- Utilities
- Tools
- Help

Each pull down menu and its options are described in the following sections.

4.3.2.1 File

The File menu includes the following selections:

- **File > Connect...**
Opens the instrument selection dialog.
- **File > Save Configuration As...**
Saves configuration as a text file.
- **File > Load Configuration...**
Load the previously saved configuration file.
- **File > Exit**
Exits the soft front panel.

4.3.2.2 View

The *View* menu includes the following selections:

- **View > Refresh**
Reads the instrument state and updates all fields.
- **View > Hide**
Minimizes the Soft Front Panel to the system tray.

4.3.2.3 Utilities

The *Utility* menu includes the following selections:

- **Utilities > Reset**
Resets the instrument, reads the state, and updates all fields.
- **Utilities > Self Test...**
Opens the “Self Test” window to start the self-test and display the result after completion.

4.3.2.4 Tools

The *Tools* menu includes the following selections:

- **Tools > Monitor Driver Calls**
Opens the “Driver Call Log” window.

4.3.2.5 Help

The *Help* menu includes the following selections:

- **Help > Driver Help**
Opens the IVI driver online help.
- **Help > Online Support**
Opens the instrument’s product support web page.
- **Help > About**
Displays revision information for hardware, software and firmware. Displays the serial number of the connected module.

4.3.3 Status Bar

The *Status Bar* contains the following two fields from left to right:

- Connection Status
 - “Not Connected” – No instrument is connected.
 - “Connected: <Instrument resource string>” – An instrument is connected. The resource string, for example PXI36::0::0::INSTR is displayed.
 - “Simulation Mode” – No real instrument is connected. The user interface is in simulation mode.
Click this field to open the “Connect to Instrument” dialog.
- Instrument status
Displays the instrument status, for example “Reset complete” after issuing a reset command.

4.3.4 Tabs (Module/Clock/Trigger/Dynamic Control Tabs)

These tabs are used to configure the most important parameters of the M8197A module. They are described in detail in the sections that follow.

The bottom part of the tab area contains the following controls from left to right:

- Error status icon: See [Errors List Window](#).
- Configuration/Operation Mode button: This toggle button is used to switch between “Configuration” and “Operation” mode. While in “Operation” mode if signal generation is started this check box is disabled. You need to stop the signal generation to switch to “Configuration” mode.
- Run/Stop button: The Run/Stop button is used to switch between Run and Program mode.

4.3.5 Numeric Control Usage

The numeric control is used to adjust the value and units. Whenever you bring the mouse pointer over the numeric control, a tooltip appears which shows the possible values in that range.

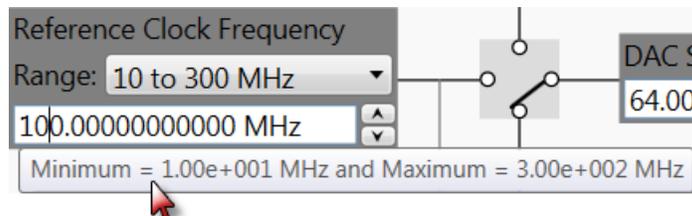


Figure 7 Tooltip showing possible values in the range

The numeric controls can be used in the following ways:

- Use the up/down arrows to change the value. The control automatically stops at the maximum/minimum allowed value.
- You can increase or decrease the value starting at a specific portion of the value. To do this, place the cursor to the right of the targeted digit and use the up/down arrows. This is especially useful when changing a signal characteristic that is immediately implemented, and observing the result in another instrument. For example, you can change the signal generator's frequency by increments of 10 MHz and observe the measured result in a signal analyzer:

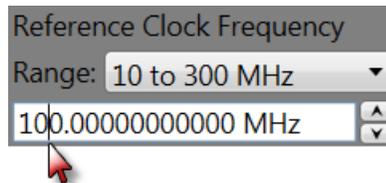


Figure 8 Typing directly into the field

- Type directly into the field and press the Enter key. If you enter a value outside the allowed range, the control automatically limits the entered value to the maximum or minimum allowed value.
- When you type the value, you can type the first letter of the allowed unit of measure to set the units. For example, in the Frequency control you can use "H", "K", "M", or "G" to specify hertz, kilohertz, megahertz, or gigahertz, respectively. (The control is not case sensitive.)

The controls allow scientific notation if it is appropriate to the allowed range. Type the first decimal number, enter an "E", and omit any trailing zeroes. For example, in the Frequency control you can type 2.5e+9 and press Enter to set the frequency to 2.5 GHz. (The plus sign is automatically inserted if it is omitted.)

4.4 Driver Call Log Window

Use this window to inspect the sequence of SCPI commands used to configure the M8197A module.

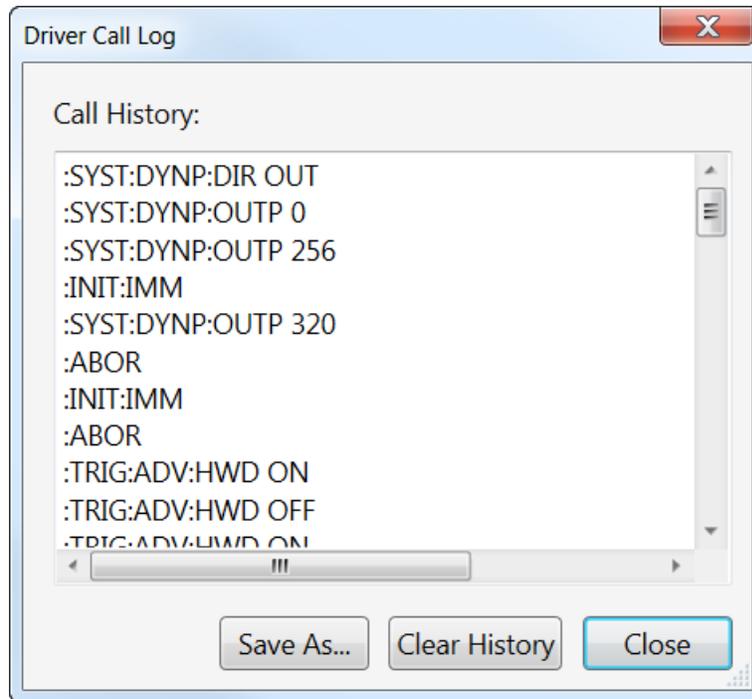


Figure 9 Driver Call Log Window

It has the following buttons:

- Save As...
Saves the Driver Call Log as a text file.
- Clear History
Clears the Driver Call Log.
- Close
Exits the window.

4.5 Errors List Window

Use this window to view errors, warnings, and information.

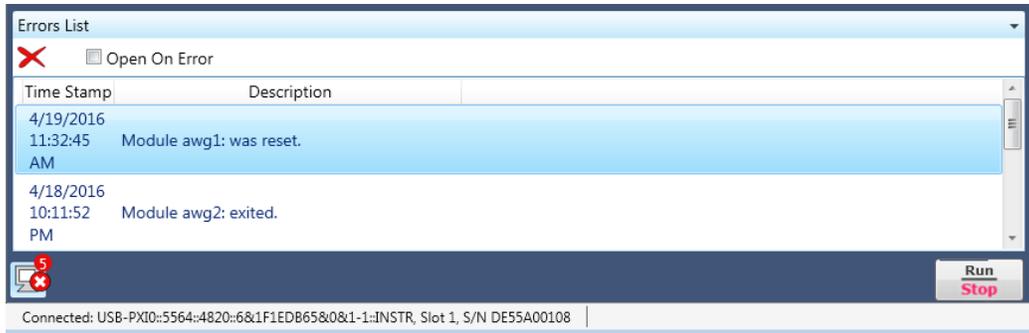


Figure 10 Errors List Window

It has the following controls, signs, and columns:

1. Open On Error
Select this check box to automatically open the errors list window whenever an error occurs. This window will show error details i.e time stamp and description.
2.  (Clear All)
Use this option to clear all the errors from the errors list window.
3.  or  (Hide Errors List Window or Show Errors List Window)
Use this toggle option to respectively show or hide the errors list window. It also shows total number of errors in the list. When the window has no errors, the green tick icon will appear.
4.  (Error)
This icon represents an error.
5.  (Warning)
This icon represents a warning.
6.  (Information)
This icon represents an information.
7. Time Stamp
This column lists the time stamp of individual errors in the format: DD/MM/YYYY HH:MM:SS.
8. Description
This column provides the description of individual errors.
9.  (Window Controls)
This drop down list provides window control options like:
 - Float
 - Dock
 - Auto Hide
 - Close

4.6 Module Tab

The module panel allows you to discover available M8195A modules and to define a multi-module group consisting of up to four slave modules. The VISA resource strings for available M8195A modules are displayed in a list under column "VISA Resource". The drop down list under column "Mode" provides options to specify whether a module will be part of multi-module group or not. Select "Slave" to add a module to the multi-module group. The option "None" indicates that the module is not part of the group. The module tab also allows you to switch between "Configuration" and "Operation" mode using the "Configuration Mode" check box.

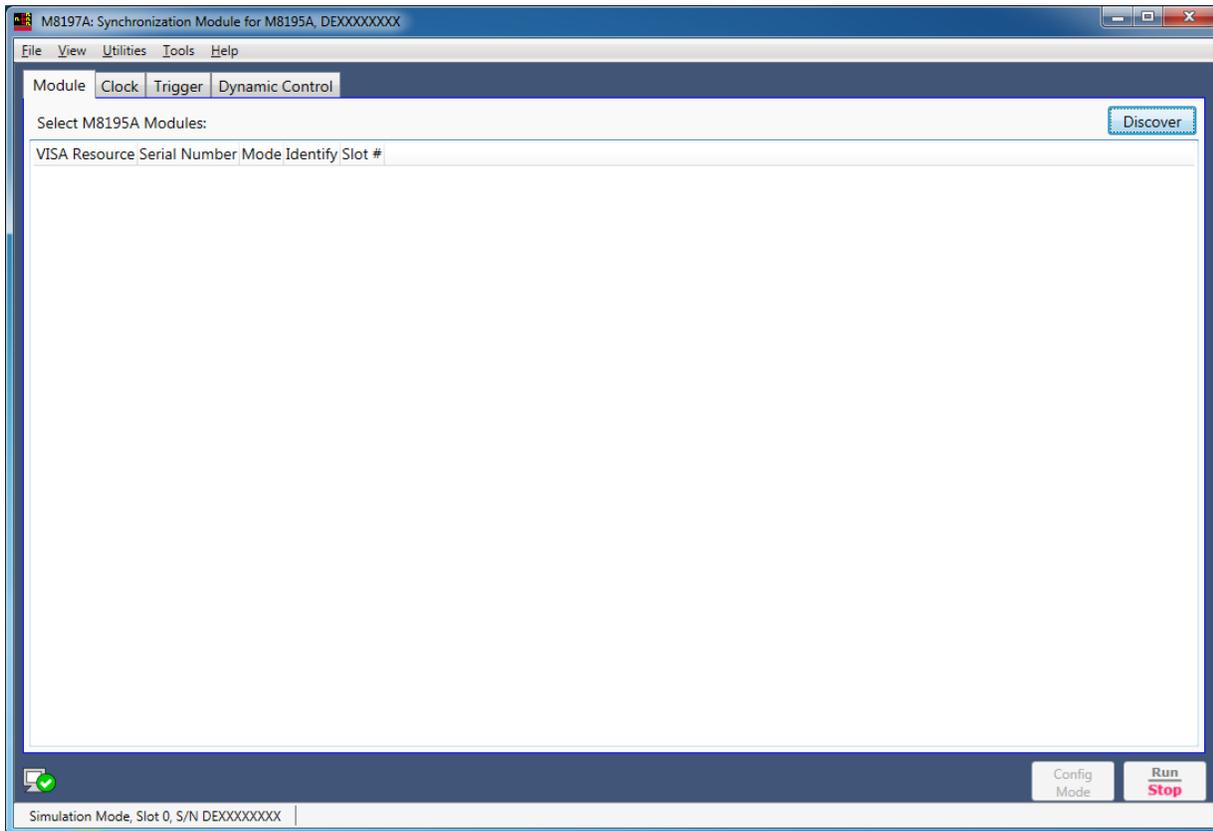


Figure 11 Module Tab

It has the following controls:

- Discover: Click this button to find the available M8195A modules. The modules that are found are displayed in the list. The firmware of the modules to be discovered must be running and the modules must be entered into the Keysight Connection Expert.
- M8195A Module Selection List: It has following columns:
 - VISA Resource: Displays the visa resource string of the M8195A module.
 - Mode: The combo-box in this column can be used to set the multi-module mode of the module. Select “Slave” to add a module to synchronization group. The option “None” is used to indicate that the module is not part of the synchronization group.
 - Serial Number: Displays the serial number of M8195A module.
 - Slot Number: Displays the slot number in AXIe chassis.
 - Chassis: Displays the AXIe chassis information.
 - Identify: The “Identify” button under this column is used to identify a module. On clicking this button the access LED of the M8195A module will be flashed for 10 seconds. This allows easy identification of module in a setup consisting of multiple AXI frames and multiple modules.

NOTE

It is recommended to follow the below order when exiting the application:

- Stop the system.
 - Switch to Configuration Mode.
 - Exit the M8197 Soft Front Panel.
 - Exit any M8195 Soft Front Panel if necessary.
 - Exit the M8195 firmware instances if not required any more.
-

4.7 Clock Tab

Use this tab to configure the SYS Clock Out and the Reference Clock of the M8197A module. It contains switches for internal clock selection and input fields to configure the relevant frequencies.

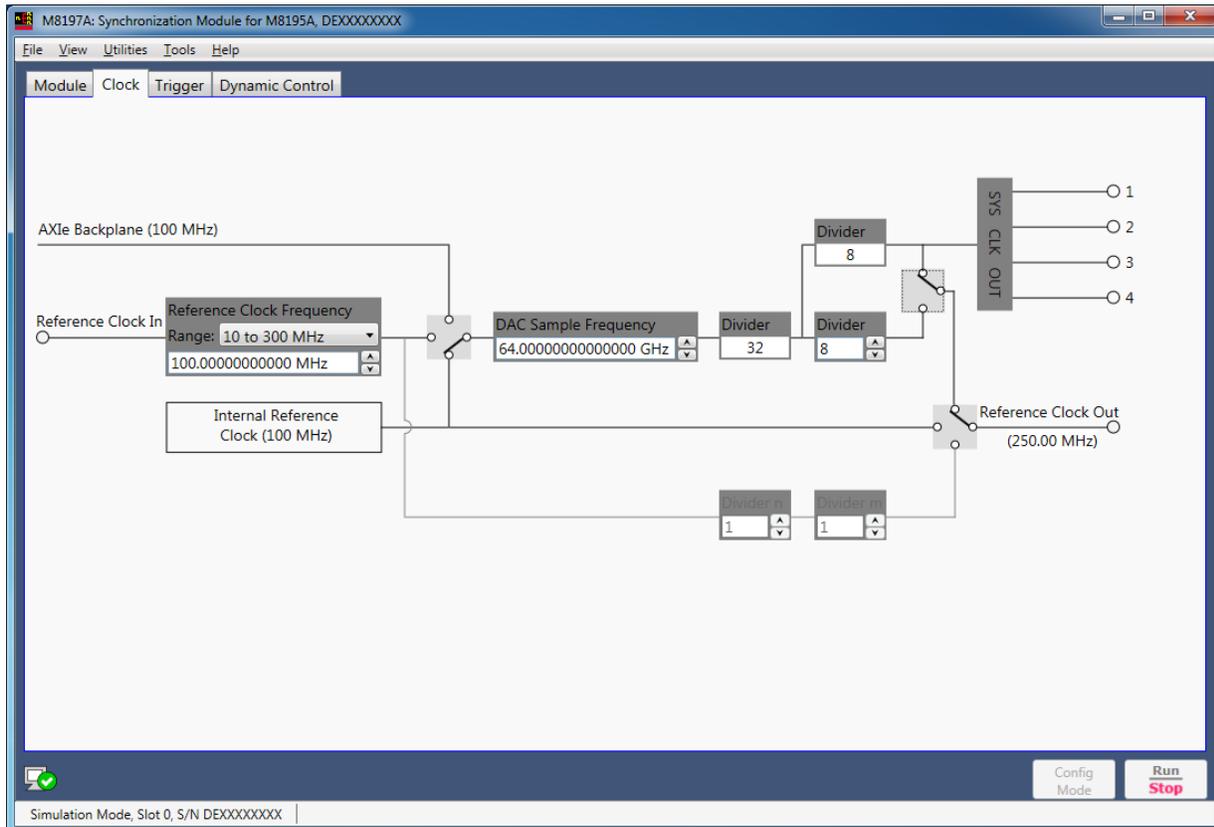


Figure 12 Clock Tab

- Reference clock selection switch
 - This switch selects between the different reference clock sources.
 - Internal: Reference from internal oscillator
 - Internal Backplane 100 MHz: Reference from AXIe Backplane
- Internal sample frequency
 - If internal sample clock is selected, this field specifies the frequency of the internally generated sample clock.

4.8 Trigger Tab

Use this tab to configure the trigger and event input parameters. It allows user to send software triggers and events to the module.

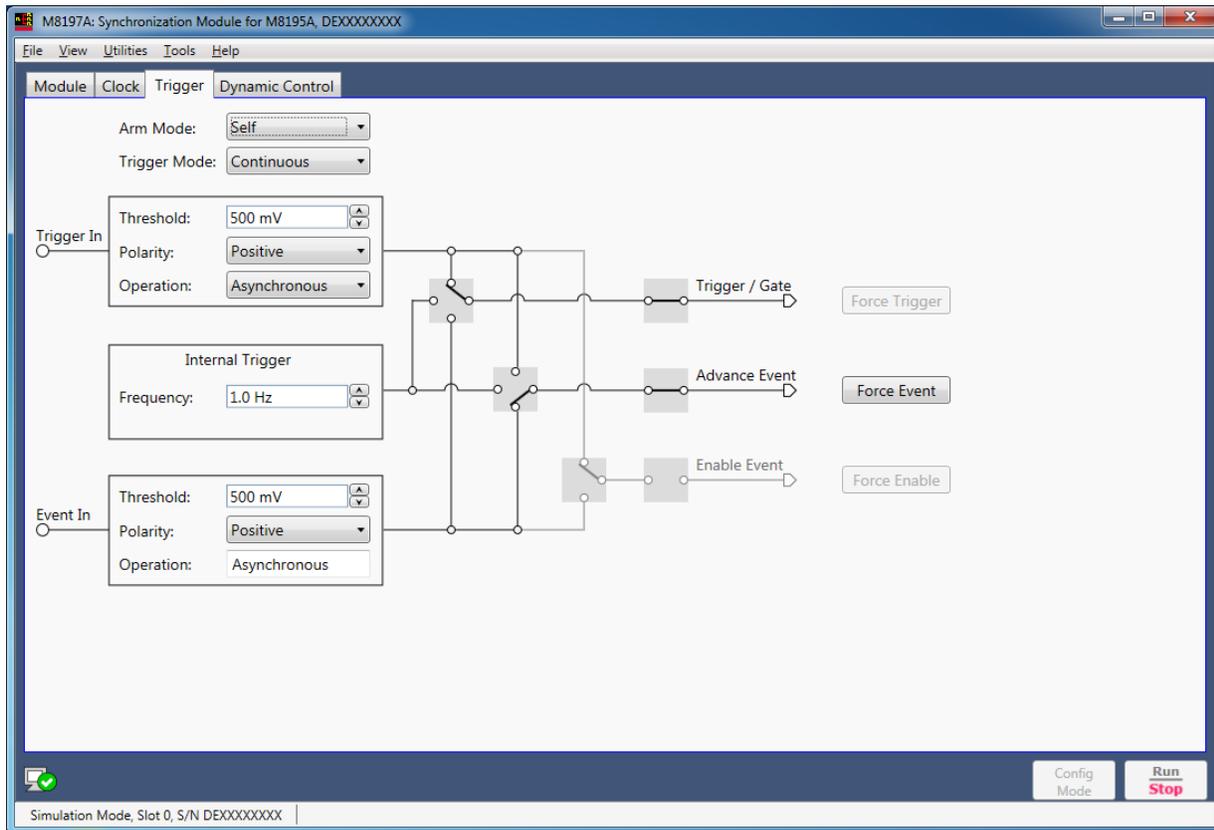


Figure 13 Trigger Tab

This tab has the following configurable fields:

- Arm mode
 - Armed – Signal generation starts when an “enable” event is received.
 - Self – Signal generation starts as defined by the trigger mode.
- Trigger mode
 - Continuous – Signal generation starts immediately after pressing the Run button. No trigger needed.
 - Triggered – Signal generation starts after a trigger is received.
 - Gated – Signal generation starts when a rising edge is received on the trigger input and pauses when a falling edge is received. Signal generation restarts after the next rising edge.
- Threshold
Specifies the threshold voltage for a software trigger or event.
- Polarity
Specifies the polarity for a software trigger or event viz. Negative, Positive, or Either.
- Operation
Specifies whether the trigger or event operation is Synchronous or Asynchronous. Operation mode is same for both trigger and event input.
- Frequency
Specifies the frequency for internal trigger.
- Force Trigger
Use this button to send a software trigger to a channel.
- Force Event
Use this button to send a software event to a channel.
- Force Enable
Use this button to send a software “enable” to a channel.

4.9 Dynamic Control Tab

Use this tab to dynamically control the output by configuring the available set of 13 registers. Hex value of the enabled registers is displayed via the 'Value' field. Registers can be individually enabled by a click, or a hex value can be directly entered into the 'Value' field to enable the desired registers.

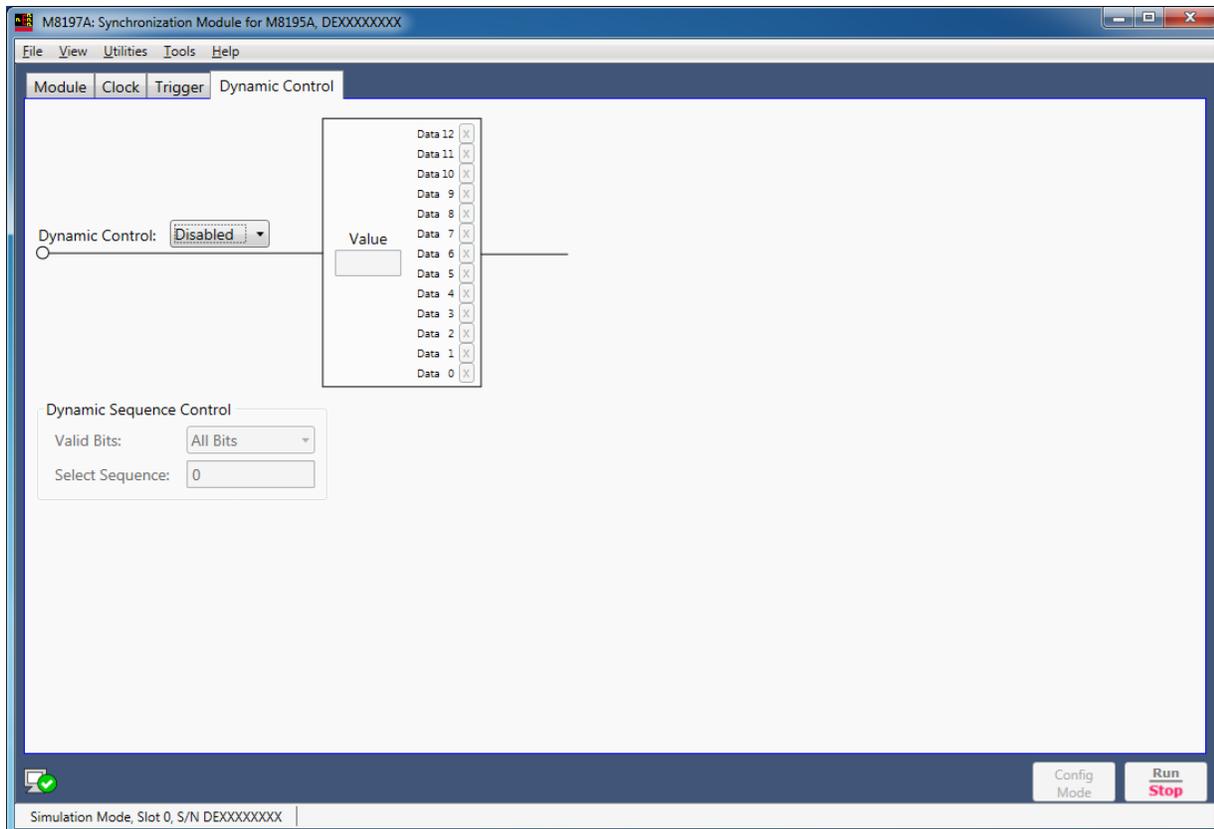


Figure 14 Dynamic Control Tab

Dynamic control has three states:

1. Input
Enables dynamic control for the input.
2. Output
Enables dynamic control for the output.
3. Disabled
Disables dynamic control for both input and output.

Dynamic sequence control has following controls:

- Valid Bits
Allows to select valid bits.
- Select Sequence:
Allows to select a sequence.

5 Remote Programming

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5.1 Introduction

This chapter describes the SCPI commands that are used to program M8197A module.

5.2 SCPI Programming

The SCPI programming is supported by the following three LAN protocols:

- **VXI-11:** The Visa Resource String is e.g. "TCPIP0::localhost::inst0::INSTR".
- **HiSLIP:** this protocol is recommended. It offers the functionality of VXI-11 protocol with better performance that is near socket performance. Visa Resource Strings look like "TCPIP0::localhost::hislip0::INSTR". The correct resource string is shown in the M8197A Soft Front Panel's "About" dialog under "VISA Resource String for...". To use the HiSLIP protocol an I/O library such as the Keysight I/O Libraries Suite must be installed. Since the protocol is new it might not be supported by the installed I/O library. The Keysight I/O Libraries Suite 16.1 and above supports it. However, the Keysight I/O Libraries Suite might be installed as secondary I/O library. In this case, check if the primary I/O library supports HiSLIP. If it does not, the socket protocol must be used.
- **Socket:** this protocol can be used with any I/O library or using standard operating system socket functionality connecting to port 5025. This protocol must be used if the used I/O library is not supporting HiSLIP protocol. Visa Resource string looks like "TCPIP0::localhost::5025::SOCKET", the exact resource string can be seen in the M8197A Soft Front Panel's "About" dialog under "VISA Resource String for...".

NOTE

AgM8197 Firmware.exe must be started prior to sending SCPI to the instrument. (See [AgM8197SFP.exe](#))

5.2.1 AgM8197SFP.exe

The M8197A Software Front Panel and Firmware are one application. You need to start M8197 Soft Front Panel (AgM8197SFP.exe) before sending SCPI commands to the instrument. This can be done in the Windows *Start* menu (*Keysight* → *M8197* → *M8197 Soft Front Panel*). You can open the “About” dialog from the M8197A Soft Front Panel to see the VISA Resource String for the different connection types.

5.2.1.1 Command Line Arguments

(See [Communication](#) for details about `/Socket`, `/Telnet`, `/Inst`, `/HiSLIP`, `/AutoID`, `/NoAutoID`, `/FallBack`).

Table 9 Command Line Arguments

Option	Description
<code>/Socket socketPort</code>	Set the socket port at which the firmware waits for SCPI commands
<code>/Telnet telnetPort</code>	Set the telnet port at which the firmware waits for SCPI commands
<code>/Inst instrumentNumber</code>	Set the instrument number (instN, hislipN) at which the firmware waits for SCPI commands
<code>/HiSLIP hislipNumber</code>	Set the instrument number for HiSLIP SCPI communication. If not specified, the same number as for VXI-11.3 is used.
<code>/AutoID</code>	Automatically select ports and number for the connections (default behavior).
<code>/NoAutoID</code>	Disable the default behavior; i.e. do not automatically select ports and number for the connections.
<code>/FallBack</code>	Try to find unused ports and number if starting a server fails.
<code>/NoSplash</code>	Do not show the splash screen.
<code>/Minimized</code>	Start with the SFP window minimized to the Windows task bar.
<code>/Title "title"</code>	Additional information shown in the SFP window title.
<code>/OutputDir</code>	Set the output directory for the log file and temporary files.
<code>/r resourceName</code>	VISA PXI resource string of the module to connect to, e.g. PXI12::0::INSTR. If this is the last parameter on the command line, the “/r” can be omitted.
<code>/Slave slaveModule</code>	Add an M8195 clock slave module (LAN VISA resource string, i.e. SOCKET, INST, or HiSLIP)

5.2.1.2 Communication

Depending on the command line arguments `/Socket`, `/Telnet`, `/Inst`, `/AutoID`, `/NoAutoID`, `/Fallback` the firmware starts several servers to handle SCPI commands. (Refer to the table above.)

`/Socket`, `/Telnet`, `/Inst`: If -1, don't start the respective servers

- Defaults:
 - Socket port: 5025 (e.g. TCPIP0::localhost::5025::SOCKET)
 - Telnet port: 5024
 - HiSLIP: 0 (e.g. TCPIP0::localhost::hislip0::INSTR)
 - VXI-11.3: 0 (TCPIP0::localhost::inst0::INSTR)

`/Fallback`: If starting a server fails because of a conflict, try using another port or number

- HiSLIP, VXI-11.3: increase the index until a server can be started successfully
- Socket, Telnet: start with the port 60000, then increase it until the servers can be started successfully. If neither socket nor telnet is disabled the firmware tries to start the servers on two consecutive ports
- (socket port = telnet port + 1)

`/AutoID`: Automatically select ports and number for the connections, which are unique per instrument.

- This is the default behavior; it is not necessary to specify this argument on the command line.
- If only one AXIe module is connected to this PC and it is an M8197 module, first try to use the command line arguments `/Socket`, `/Telnet`, `/Inst` or their respective default values if they are not specified. If starting the servers fails, proceed with the steps below.
- `/Socket`, `/Telnet`, `/Inst` are ignored (unless they are -1 and a server is disabled)
- If the firmware detects more than one AXIe module, use a special mechanism to obtain a number for the HiSLIP and VXI-11.3 servers, which makes sure that the firmware uses always the same VISA resource string per module
- The socket and telnet port are then calculated from the HiSLIP index:
 - telnet port = 60000 + 2 * <HiSLIP index>
 - socket port = 60000 + 2 * <HiSLIP index> + 1

`/NoAutoID`: Do not automatically select ports and number for the connections, use the values specified with `/Socket`, `/Telnet`, `/Inst` or their respective default values instead.

If both `/NoAutoID` and `/AutoID` are specified, `/AutoID` overrides `/NoAutoID`.

5.3 Programming Recommendations

This section lists some recommendations for programming the instrument.

Start programming from the default setting. The common command for setting the default setting is:

```
*RST
```

The SCPI standard defines a long and a short form of the commands. For fast programming speed, it is recommended to use the short forms. The short forms of the commands are represented by upper case letters. For example the short form of the command to start/begin event to all channels of the multi-module group is:

```
: TRIG: BEG
```

To improve programming speed it is also allowed to skip optional subsystem command parts. Optional subsystem command parts are depicted in square brackets, e.g. :TRIGger[:SEQuence][:START]:BEGin[:IMMediate]

If it is important to know whether the last command is completed then send the common query:

```
*OPC?
```

It is recommended to test the new setting which will be programmed on the instrument by setting it up manually. When you have found the correct setting, then use this to create the program.

In the program it is recommended to send the command for starting data generation (:INIT:IMM) as the last command. This way intermediate stop/restarts are avoided and optimum execution performance is achieved.

```
*RST           # set default settings
...           # other commands to set modes
...           # and parameters
:ARM:TRIG:IMP HIGH # set trigger impedance to High
:INIT:IMM      # start data generation.
```

5.4 System Related Commands (SYSTEM Subsystem)

5.4.1 :SYSTEM:ERRor[:NEXT]?

Command	:SYST:ERR?
Long	:SYSTEM:ERRor?
Parameters	None
Parameter Suffix	None
Description	<p>Read and clear one error from the instrument's error queue.</p> <p>A record of up to 30 command syntax or hardware errors can be stored in the error queue. Errors are retrieved in first-in-first-out (FIFO) order. The first error returned is the first error that was stored. Errors are cleared as you read them.</p> <p>If more than 30 errors have occurred, the last error stored in the queue (the most recent error) is replaced with "Queue overflow". No additional errors are stored until you remove errors from the queue.</p> <p>If no errors have occurred when you read the error queue, the instrument responds with 0, "No error".</p> <p>The error queue is cleared by the *CLS command, when the power is cycled, or when the firmware is re-started.</p> <p>The error queue is not cleared by a reset (*RST) command.</p> <p>The error messages have the following format (the error string may contain up to 255 characters):</p> <p>error number,"Description", e.g.</p> <p>-113,"Undefined header".</p>
Example	<p>Query</p> <p>:SYST:ERR?</p>

5.4.2 :SYSTEM:HELP:HEADers?

Command	:SYST:HELP:HEAD?
Long	:SYSTEM:HELP:HEADers?
Parameters	None
Parameter Suffix	None
Description	<p>The HEADers? query returns all SCPI commands and queries and IEEE 488.2 common commands and common queries implemented by the instrument. The response is a <DEFINITE LENGTH ARBITRARY BLOCK RESPONSE DATA> element. The full path for every command and query is returned separated by linefeeds. The syntax of the response is defined as: The <nonzero digit> and sequence of <digit> follow the rules in IEEE 488.2, Section 8.7.9. An <SCPI header> is defined as: It contains all the nodes from the root. The <SCPI program mnemonic> contains the node in standard SCPI format. The short form uses uppercase characters while the additional characters for the long form are in lowercase characters. Default nodes are surrounded by square brackets (□).</p>
Example	<p>Query</p> <p>:SYST:HELP:HEAD?</p>

5.4.3 :SYSTem:LiCense:EXTEnded:LIST?

Command	:SYST:LiC:EXt:LIST?
Long	:SYSTem:LiCense:EXTEnded:LIST?
Parameters	None
Parameter Suffix	None
Description	This query lists the licenses installed.
Example	Query :SYST:LiC:EXt:LIST?

5.4.4 :SYSTem:SET[?]

Command	:SYST:SET[?]
Long	:SYSTem:SET[?]
Parameters	<binary block data>
Parameter Suffix	None
Description	In query form, the command reads a block of data containing the instrument's complete set-up. The set-up information includes all parameter and mode settings, but does not include the contents of the instrument setting memories or the status group registers. The data is in a binary format, not ASCII, and cannot be edited. In set form, the block data must be a complete instrument set-up read using the query form of the command. This command has the same functionality as the *LRN command.
Example	Command :SYST:SET <binary block data> Query :SYST:SET?

5.4.5 :SYSTem:VERSiOn?

Command	:SYST:VERS?
Long	:SYSTem:VERSiOn?
Parameters	None
Parameter Suffix	None
Description	This query returns a formatted numeric value corresponding to the SCPI version number for which the instrument complies, for example "1999.0".
Example	Query :SYST:VERS?

5.4.6 :SYSTem:COMMunicate:*?

These queries return information about the instrument firmware's available connections. If a connection is not available the returned value is -1.

This is only useful if there is more than one Keysight module connected to a PC, otherwise one would normally use the default connections (HiSLIP and VXI-11 instrument number 0, socket port 5025, telnet port 5024)

One can never be sure if a socket port is already in use, so one could e.g. specify a HiSLIP number on the command line (`AgM8197Firmware.exe /AutoID /i 5 /Fallback /r ...`) and let the firmware find an unused socket port. Then this socket port can be queried using the HiSLIP connection.

5.4.6.1 :SYSTem:COMMunicate:INSTr[:NUMBer]?

Command	<code>:SYST:COMM:INST?</code>
Long	<code>:SYSTem:COMMunicate:INSTr?</code>
Parameters	None
Parameter Suffix	None
Description	This query returns the VXI-11 instrument number used by the firmware.
Example	Query <code>:SYST:COMM:INST?</code>

5.4.6.2 :SYSTem:COMMunicate:HISLip[:NUMBer]?

Command	<code>:SYST:COMM:HISL?</code>
Long	<code>:SYSTem:COMMunicate:HISLip?</code>
Parameters	None
Parameter Suffix	None
Description	This query returns the HiSLIP number used by the firmware.
Example	Query <code>:SYST:COMM:HISL?</code>

5.4.6.3 :SYSTem:COMMunicate:SOCKet[:PORT]?

Command	<code>:SYST:COMM:SOCK?</code>
Long	<code>:SYSTem:COMMunicate:SOCKet?</code>
Parameters	None
Parameter Suffix	None
Description	This query returns the socket port used by the firmware.
Example	Query <code>:SYST:COMM:SOCK?</code>

5.4.6.4 :SYSTem:COMMunicate:TELNet[:PORT]?

Command	:SYST:COMM:TELN?
Long	:SYSTem:COMMunicate:TELNet?
Parameters	None
Parameter Suffix	None
Description	This query returns the telnet port used by the firmware.
Example	Query :SYST:COMM:TELN?

5.4.7 :SYSTem:DYNPort:*

5.4.7.1 :SYSTem:DYNPort:DIRection[?] DISabled|INPut|OUTPut

Command	:SYST:DYNP:DIR[?]
Long	:SYSTem:DYNPort:DIRection[?]
Parameters	DISabled INPut OUTPut
Parameter Suffix	None
Description	Set or query the signal direction of the dynamic control interface. <ul style="list-style-type: none"> • DISabled – interface is disabled • INPut – interface is used for dynamic control / GPIO in • OUTPut – interface is used for GPIO out
Example	Command :SYST:DYNP:DIR OUTP
	Query :SYST:DYNP:DIR?

:

5.4.7.2 SYSTem:DYNPort:OUTPut[?] <value>|MINimum|MAXimum

Command	:SYST:DYNP:OUTP[?]
Long	:SYSTem:DYNPort:OUTPut[?]
Parameters	<value> MINimum MAXimum
Parameter Suffix	None
Description	Set or query the state of the 13 data pins in the dynamic control interface.
Example	Command :SYST:DYNP:OUTP 0x1234
	Query :SYST:DYNP:OUTP?

5.4.7.3 :SYSTem:DYNPort:OUTPut:PIN[?] <pin>,0|1|OFF|ON

Command	:SYST:DYNP:OUTP:PIN[?]
Long	:SYSTem:DYNPort:OUTPut:PIN[?]
Parameters	<pin>,0 1 OFF ON
Parameter Suffix	None
Description	Set or query the state of a single data pin in the dynamic control interface.
Example	Command :SYST:DYNP:OUTP:PIN 12,ON
	Query :SYST:DYNP:OUTP:PIN? 12

5.5 Common Command List

5.5.1 *IDN?

Read the instrument's identification string, which contains four fields separated by commas. The first field is the manufacturer's name, the second field is the model number, the third field is the serial number, and the fourth field is a revision code which contains four numbers separated dots and a fifth number separated by a dash: Keysight Technologies, M8197A,<serial number>, x.x.x.x-h
 x.x.x.x= Firmware revision number, e.g. 2.0.0.0
 h= Hardware revision number

5.5.2 *CLS

Clear the event register in all register groups. This command also clears the error queue and cancels a *OPC operation. It doesn't clear the enable register.

5.5.3 *ESE

Enable bits in the Standard Event Status Register to be reported in the Status Byte. The selected bits are summarized in the "Standard Event" bit (bit 5) of the Status Byte Register. The *ESE? query returns a value which corresponds to the binary-weighted sum of all bits enabled decimal by the *ESE command. These bits are not cleared by a *CLS command. Value Range: 0–255.

5.5.4 *ESR?

Query the Standard Event Status Register. Once a bit is set, it remains set until cleared by a *CLS (clear status) command or queried by this command. A query of this register returns a decimal value which corresponds to the binary-weighted sum of all bits set in the register.

5.5.5 *OPC

Set the "Operation Complete" bit (bit 0) in the Standard Event register after the previous commands have been completed.

5.5.6 *OPC?

Return "1" to the output buffer after the previous commands have been completed. Other commands cannot be executed until this command completes.

5.5.7 *OPT?

Read the installed options. The response consists of any number of fields separated by commas.

5.5.8 *RST

Reset instrument to its factory default state.

5.5.9 *SRE[?]

Enable bits in the Status Byte to generate a Service Request. To enable specific bits, you must write a decimal value which corresponds to the binary-weighted sum of the bits in the register. The selected bits are summarized in the “Master Summary” bit (bit 6) of the Status Byte Register. If any of the selected bits change from “0” to “1”, a Service Request signal is generated. The *SRE? query returns a decimal value which corresponds to the binary-weighted sum of all bits enabled by the *SRE command.

5.5.10 *STB?

Query the summary (status byte condition) register in this register group. This command is similar to a Serial Poll but it is processed like any other instrument command. This command returns the same result as a Serial Poll but the “Master Summary” bit (bit 6) is not cleared by the *STB? command.

5.5.11 *TST?

Execute Self Tests. If self-tests pass, a 0 is returned. A number larger than 0 indicates the number of failed tests.

To get actual messages, use :TEST:TST?

5.5.12 *LRN?

Query the instrument and return a binary block of data containing the current settings (learn string). You can then send the string back to the instrument to restore this state at a later time. For proper operation, do not modify the returned string before sending it to the instrument. Use :SYST:SET to send the learn string. See section [5.4.4](#).

5.5.13 *WAI

Prevents the instrument from executing any further commands until the current command has finished executing.

5.6 Status Model

Introduction

This section describes the structure of the SCPI status system used by the M8197A. The status system records various conditions and states of the instrument in several register groups as shown on the following pages. Each of the register groups is made up of several low level registers called Condition registers, Event registers, and Enable registers which control the action of specific bits within the register group.

These groups are explained below:

- A condition register continuously monitors the state of the instrument. The bits in the condition register are updated in real time and the bits are not latched or buffered. This is a read-only register and bits are not cleared when you read the register. A query of a condition register returns a decimal value which corresponds to the binary-weighted sum of all bits set in that register.
- An event register latches the various events from changes in the condition register. There is no buffering in this register; while an event bit is set, subsequent events corresponding to that bit are ignored. This is a read only register. Once a bit is set, it remains set until cleared by query command (such as `STAT:QUES:EVEN?`) or a `*CLS` (clear status) command. A query of this register returns a decimal value which corresponds to the binary-weighted sum of all bits set in that register.
- An enable register defines which bits in the event register will be reported to the Status Byte register group. You can write to or read from an enable register. A `*CLS` (clear status) command will not clear the enable register but it does clear all bits in the event register. A `STAT:PRES` command clears all bits in the enable register. To enable bits in the enable register to be reported to the Status Byte register, you must write a decimal value which corresponds to the binary weighted sum of the corresponding bits.
- Transition Filters are used to detect changes of the state in the condition register and set the corresponding bit in the event register. You can set transition filter bits to detect positive transitions (PTR), negative transitions (NTR) or both. Transition filters are read/write registers. They are not affected by `*CLS`.

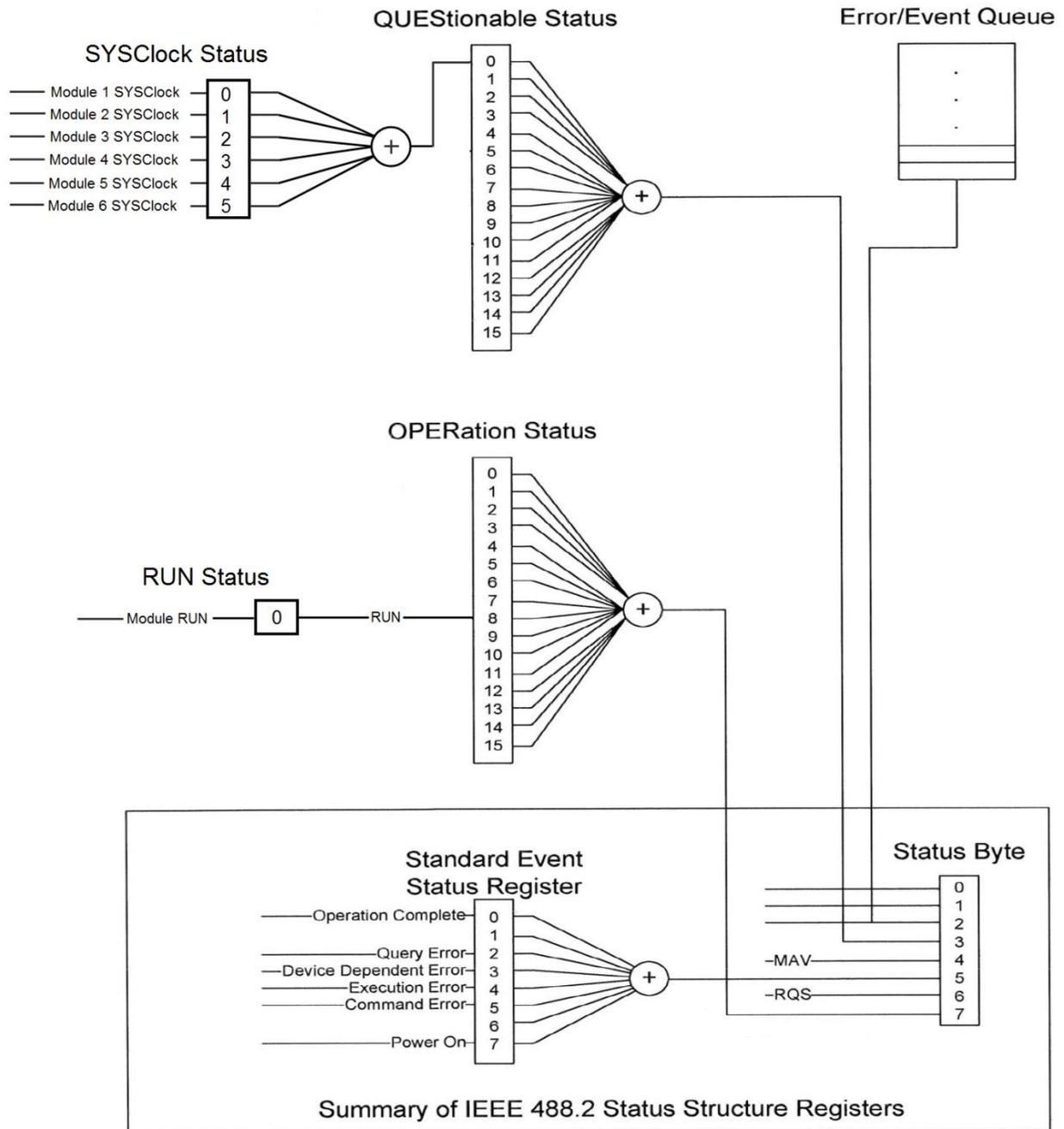


Figure 15 Status Register Structure

5.6.1 :STATus:PRESet

Clears all status group event registers. Presets the status group enables PTR and NTR registers as follows:

ENABle = 0x0000, PTR = 0xffff, NTR = 0x0000

5.6.2 Status Byte Register

The Status Byte summary register reports conditions from the other status registers. Data that is waiting in the instrument's output buffer is immediately reported on the "Message Available" bit (bit 4) for example. Clearing an event register from one of the other register groups will clear the corresponding bits in the Status Byte condition register. Reading all messages from the output buffer, including any pending queries, will clear the "Message Available" bit. To set the enable register mask and generate an SRQ (service request), you must write a decimal value to the register using the *SRE command.

Table 10 Status Byte Register

Bit Number		Decimal Value	Definition
0	Not used	1	Not Used. Returns "0"
1	Not used	2	Not Used. Returns "0"
2	Error Queue	4	One or more error are stored in the Error Queue
3	Questionable Data	8	One or more bits are set in the Questionable Data Register (bits must be enabled)
4	Message Available	16	Data is available in the instrument's output buffer
5	Standard Event	32	One or more bits are set in the Standard Event Register
6	Master Summary	64	One or more bits are set in the Status Byte Register
7	Operational Data	128	One or more bits set in the Operation Data Register (bits must be enabled)

5.6.3 Questionable Data Register Command Subsystem

The Questionable Data register group provides information about the quality or integrity of the instrument. Any or all of these conditions can be reported to the Questionable Data summary bit through the enable register.

Table 11 Questionable Data Register

Bit Number		Decimal Value	Definition
0	SYSClock Status warning	1	One or multiple system clock outputs have been switched off (to protect themselves).
1	Not used	2	Returns "0"
2	Not used	4	Returns "0"
3	Not used	8	Returns "0"
4	Not used	16	Returns "0"
5	Not used	32	Returns "0"
6	Not used	64	Returns "0"
7	Not used	128	Returns "0"
8	Not used	256	Returns "0"
9	Not used	512	Returns "0"
10	Not used	1024	Returns "0"
11	Not used	2048	Returns "0"
12	Not used	4096	Returns "0"
13	Not used	8192	Returns "0"
14	Not used	16384	Returns "0"
15	Not used	32768	Returns "0"

The following commands access the questionable status group.

5.6.3.1 :STATus:QUEStionable[:EVENT]?

Reads the event register in the questionable status group. It's a read-only register. Once a bit is set, it remains set until cleared by this command or the *CLS command. A query of the register returns a decimal value which corresponds to the binary-weighted sum of all bits set in the register.

5.6.3.2 :STATus:QUEStionable:CONDition?

Reads the condition register in the questionable status group. It's a read-only register and bits are not cleared when you read the register. A query of the register returns a decimal value which corresponds to the binary-weighted sum of all bits set in the register.

5.6.3.3 :STATus:QUEStionable:ENABle[?]

Sets or queries the enable register in the questionable status group. The selected bits are then reported to the Status Byte. A *CLS will not clear the enable register but it does clear all bits in the event register. To enable bits in the enable register, you must write a decimal value which corresponds to the binary-weighted sum of the bits you wish to enable in the register.

5.6.3.4 :STATus:QUEStionable:NTRansition[?]

Sets or queries the negative-transition register in the questionable status group. A negative transition filter allows an event to be reported when a condition changes from true to false. Setting both positive/negative filters true allows an event to be reported anytime the condition changes. Clearing both filters disable event reporting. The contents of transition filters are unchanged by *CLS and *RST.

5.6.3.5 :STATus:QUEStionable:PTRansition[?]

Set or queries the positive-transition register in the questionable status group. A positive transition filter allows an event to be reported when a condition changes from false to true. Setting both positive/negative filters true allows an event to be reported anytime the condition changes. Clearing both filters disable event reporting. The contents of transition filters are unchanged by *CLS and *RST.

5.6.4 Operation Status Subsystem

The Operation Status register contains conditions which are part of the instrument's normal operation.

Table 12 Operation Status Register

Bit Number		Decimal Value	Definition
0	Not used	1	Returns "0"
1	Not used	2	Returns "0"
2	Not used	4	Returns "0"
3	Not used	8	Returns "0"
4	Not used	16	Returns "0"
5	Not used	32	Returns "0"
6	Not used	64	Returns "0"
7	Not used	128	Returns "0"
8	Run Status	256	Indicates if the multi-module group is in running/armed state (:INIT:IMM was executed).
9	Not used	512	Returns "0"
10	Not used	1024	Returns "0"
11	Not used	2048	Returns "0"
12	Not used	4096	Returns "0"
13	Not used	8192	Returns "0"
14	Not used	16384	Returns "0"
15	Not used	32768	Returns "0"

The following commands access the operation status group.

5.6.4.1 :STATus:OPERation[:EVENT]?

Reads the event register in the operation status group. It's a read-only register. Once a bit is set, it remains set until cleared by this command or *CLS command. A query of the register returns a decimal value which corresponds to the binary-weighted sum of all bits set in the register.

5.6.4.2 :STATus:OPERation:CONDition?

Reads the condition register in the operation status group. It's a read-only register and bits are not cleared when you read the register. A query of the register returns a decimal value which corresponds to the binary-weighted sum of all bits set in the register.

5.6.4.3 :STATus:OPERation:ENABLE[?]

Sets or queries the enable register in the operation status group. The selected bits are then reported to the Status Byte. A *CLS will not clear the enable register but it does clear all bits in the event register. To enable bits in the enable register, you must write a decimal value which corresponds to the binary-weighted sum of the bits you wish to enable in the register.

5.6.4.4 :STATus:OPERation:NTRansition[?]

Sets or queries the negative-transition register in the operation status group. A negative transition filter allows an event to be reported when a condition changes from true to false. Setting both positive/negative filters true allows an event to be reported anytime the condition changes. Clearing both filters disable event reporting. The contents of transition filters are unchanged by *CLS and *RST.

5.6.4.5 :STATus:OPERation:PTRansition[?]

Set or queries the positive-transition register in the operation status group. A positive transition filter allows an event to be reported when a condition changes from false to true. Setting both positive/negative filters true allows an event to be reported anytime the condition changes. Clearing both filters disable event reporting. The contents of transition filters are unchanged by *CLS and *RST.

5.6.5 Run Status Subsystem

The Run Status register contains the run status conditions of the multi-module group.

The following SCPI commands and queries are supported:

```
:STATus:OPERation:RUN[:EVENT]?
:STATus:OPERation:RUN:CONDition?
:STATus:OPERation:RUN:ENABLE[?]
:STATus:OPERation:RUN:NTRansition[?]
:STATus:OPERation:RUN:PTRansition[?]
```

Table 13 Run Status Register

Bit Number	Decimal Value	Definition
0 Run Status	1	Indicates if the multi-module group is in running/armed state (:INIT:IMM was executed).

5.7 ARM/TRIGger Subsystem

5.7.1 :ABORt

Command	:ABOR
Long	:ABORt
Parameters	None
Parameter Suffix	None
Description	Stop signal generation on all channels of the multi-module group.
Example	Command :ABOR

5.7.2 :INITiate:CONTInuous:ENABle[?] SELF|ARMed

Command	:INIT:CONT:ENAB[?]
Long	:INITiate:CONTInuous:ENABle[?]
Parameters	SELF ARMed
Parameter Suffix	None
Description	Set or query the arming mode.
Example	Command :INIT:CONT:ENAB SELF
	Query :INIT:CONT:ENAB?

5.7.3 :INITiate:CONTInous[:STATe][?] OFF|ON|0|1

Command	:INIT:CONT:[STAT][?]
Long	:INITiate:CONTInous:[STATe][?]
Parameters	OFF ON 0 1
Parameter Suffix	None
Description	Set or query the continuous mode. This command must be used together with INIT:GATE to set the trigger mode. 0/OFF – Continuous mode is off. If gate mode is off, the trigger mode is “triggered”, else it is “gated”. 1/ON – Continuous mode is on. Trigger mode is “automatic”. The value of gate mode is not relevant.
Example	Command :INIT:CONT:STAT ON
	Query :INIT:CONT:STAT?

5.7.4 :INITiate:GATE[:STATe][?] OFF|ON|0|1

Command	:INIT:GATE:[STAT][?]
Long	:INITiate:GATE:[STATe][?]
Parameters	OFF ON 0 1
Parameter Suffix	None
Description	Set or query the gate mode. This command must be used together with INIT:CONT to set the trigger mode. 0/OFF – Gate mode is off. 1/ON – Gate mode is on. If continuous mode is off, the trigger mode is “gated”.
Example	Command :INIT:GATE:STAT ON Query :INIT:GATE:STAT?

Table 14: Trigger mode settings

INIT:CONT	INIT:GATE	Trigger Mode
0	0	Triggered
0	1	Gated
1	0	Continuous
1	1	Continuous

5.7.5 :INITiate:IMMEDIATE

Command	:INIT:IMM
Long	:INITiate:IMMEDIATE
Parameters	None
Parameter Suffix	None
Description	Set all channels of the multi-module group to an armed state. Signal generation is started after a trigger is received.
Example	Command :INIT:IMM

5.7.6 :ARM[:SEQuence][:STARt][:LAYer]:TRIGger:LEVel[?] <level>|MINimum|MAXimum

Command	:ARM[:SEQ] [:STAR] [:LAY]:TRIG:LEV[?]
Long	:ARM[:SEQuence] [:STARt] [:LAYer]:TRIGger:LEVel[?]
Parameters	<level> MINimum MAXimum
Parameter Suffix	Volt (V) or millivolt (mV)
Description	Set or query the threshold level of the M8197A trigger input. <level> – Threshold level voltage.
Example	Command :ARM:TRIG:LEV 3e-9
	Query :ARM:TRIG:LEV?

5.7.7 :ARM[:SEQuence][:STARt][:LAYer]:TRIGger:SLOPe[?] POSitive|NEGative|EITHer

Command	:ARM[:SEQ] [:STAR] [:LAY]:TRIG:SLOP[?]
Long	:ARM[:SEQuence] [:STARt] [:LAYer]:TRIGger:SLOPe[?]
Parameters	POSitive NEGative EITHer
Parameter Suffix	None
Description	Set or query the trigger input slope. <ul style="list-style-type: none"> • POSitive – rising edge • NEGative – falling edge • EITHer – both
Example	Command :ARM:TRIG:SLOP POS
	Query :ARM:TRIG:SLOP?

5.7.8 :ARM[:SEQuence][:STARt][:LAYer]:TRIGger:SOURce[?] TRIGger|EVENT|INTernal

Command	:ARM[:SEQ][[:STAR][[:LAY]:TRIG:SOUR[?]
Long	:ARM[:SEQuence][[:STARt][[:LAYer]:TRIGger:SOURce[?]
Parameters	TRIGger EVENT INTernal
Parameter Suffix	None
Description	Set or query the source for the trigger function. <ul style="list-style-type: none"> • TRIGger - trigger input • EVENT - event input • INTernal - internal trigger generator
Example	<p>Command</p> <pre>:ARM:TRIG:SOUR TRIG</pre> <p>Query</p> <pre>:ARM:TRIG:SOUR?</pre>

5.7.9 :ARM[:SEQuence][:STARt][:LAYer]:TRIGger:FREQuency[?] <frequency>|MINimum|MAXimum

Command	:ARM[:SEQ][[:STAR][[:LAY]:TRIG:FREQ[?]
Long	:ARM[:SEQuence][[:STARt][[:LAYer]:TRIGger:FREQuency[?]
Parameters	<frequency> MINimum MAXimum
Parameter Suffix	None
Description	Set or query the frequency of the internal trigger generator. <ul style="list-style-type: none"> • <frequency> - internal trigger frequency
Example	<p>Command</p> <pre>:ARM:TRIG:FREQ 1</pre> <p>Query</p> <pre>:ARM:TRIG:FREQ?</pre>

5.7.10 :ARM[:SEQuence][:STARt][:LAYer]:TRIGger:OPERation[?] ASYNchronous|SYNChronous

Command	:ARM[:SEQ] [:STAR] [:LAY] :TRIG:OPER[?]
Long	:ARM[:SEQuence] [:STARt] [:LAYer] :TRIGger:OPERation[?]
Parameters	ASYNchronous SYNChronous
Parameter Suffix	None
Description	Set or query the M8197A's trigger operation mode.
Example	Command :ARM:TRIG:OPER SYNC
	Query :ARM:TRIG:OPER?

5.7.11 :ARM[:SEQuence][:STARt][:LAYer]:EVENT:LEVel[?] <level>|MINimum|MAXimum

Command	:ARM[:SEQ] [:STAR] [:LAY] :EVEN:LEV[?]
Long	:ARM[:SEQuence] [:STARt] [:LAYer] :EVENT:LEVel[?]
Parameters	<level> MINimum MAXimum
Parameter Suffix	Volt (V) or millivolt (mV)
Description	Set or query the threshold level of the M8197A event input. <level> – Threshold level voltage.
Example	Command :ARM:EVEN:LEV 3e-9
	Query :ARM:EVEN:LEV?

5.7.12 :ARM[:SEQuence][:STARt][:LAYer]:EVENT:SLOPe[?] POSitive|NEGative|EITHer

Command	:ARM[:SEQ] [:STAR] [:LAY] :EVEN:SLOP[?]
Long	:ARM[:SEQuence] [:STARt] [:LAYer] :EVENT:SLOPe[?]
Parameters	POSitive NEGative EITHer
Parameter Suffix	None
Description	Set or query the event input slope. <ul style="list-style-type: none"> • POSitive – rising edge • NEGative – falling edge • EITHer – both
Example	Command :ARM:EVEN:SLOP POS
	Query :ARM:EVEN:SLOP?

5.7.13 :ARM[:SEQuence][:START][:LAYer]:DYNPort:WIDTh[?] LOWerbits|ALLBits

Command	:ARM:DYNP:WIDT[?]
Long	:ARM:DYNPort:WIDTh[?]
Parameters	LOWerbits ALLBits
Parameter Suffix	None
Description	Use this command to set or query the number of valid bits of the dynamic control input. The input connector has 13 data pins Data_In[0..12], a Data_Select and a Load pin. Internally, 24 bits of data are used, which are multiplexed using Data_Select. Data_In[0..12] and Data_Select will be stored on rising edge of Load signal. LOWerbits – 13 Bits are used to select a segment dynamically. Data_Select = Low: Data[0..12] = Data_In[0..12]. Data[13..24] = 0. ALLBits – 24 Bits are used to select a segment dynamically. Data_Select = Low: Data[0..12] = Data_In[0..12]. Data_Select = High: Data[13..24] = Data_In[0..10].
Example	<p>Command</p> <pre>:ARM:DYNP:WIDT ALLB</pre> <p>Query</p> <pre>:ARM:DYNP:WIDT?</pre>

5.7.14 :TRIGger[:SEQuence][:START]:SOURce:ENABle[?] TRIGger|EVENT

Command	:TRIG[:SEQ][[:STAR]:SOUR:ENAB[?]
Long	:TRIGger[:SEQuence][[:START]:SOURce:ENABle[?]
Parameters	TRIGger EVENT
Parameter Suffix	None
Description	Set or query the source for the enable event. <ul style="list-style-type: none"> • TRIGger - trigger input • EVENT - event input
Example	<p>Command</p> <pre>:TRIG:SOUR:ENAB TRIG</pre> <p>Query</p> <pre>:TRIG:SOUR:ENAB?</pre>

5.7.15 :TRIGger[:SEQuence][:STARt]:ENABle:HWDisable[:STATe][?] 0|1|OFF|ON

Command	:TRIG[:SEQ][[:STARt]:ENAB:HWD[?]
Long	:TRIGger[:SEQuence][[:STARt]:ENABle:HWDisable[?]
Parameters	0 1 OFF ON
Parameter Suffix	None
Description	Set or query the hardware input disable state for the enable function. When the hardware input is disabled, an enable event can only be generated using the :TRIGger[:SEQuence][:STARt]:ENABle[:IMMediate] command. When the hardware input is enabled, an enable event can be generated by command or by a signal present at the trigger or event input.
Example	<p>Command</p> <pre>:TRIG:ENAB:HWD ON</pre> <p>Query</p> <pre>:TRIG:ENAB:HWD?</pre>

5.7.16 :TRIGger[:SEQuence][:STARt]:BEGin:HWDisable[:STATe][?] 0|1|OFF|ON

Command	:TRIG[:SEQ][[:STARt]:BEG:HWD[:STAT][?]
Long	:TRIGger[:SEQuence][[:STARt]:BEGin:HWDisable[:STATe][?]
Parameters	0 1 OFF ON
Parameter Suffix	None
Description	Set or query the M8197A's hardware input disable state for the trigger function. When the hardware input is disabled, a trigger can only be generated using the :TRIGger[:SEQuence][:STARt]:BEGin[:IMMediate] command. When the hardware input is enabled, a trigger can be generated by command or by a signal present at the trigger input of the M8197A.
Example	<p>Command</p> <pre>:TRIG:BEG:HWD ON</pre> <p>Query</p> <pre>:TRIG:BEG:HWD?</pre>

5.7.17 :TRIGger[:SEQuence][:STARt]:ADVance:HWDisable[:STATe][?] 0|1|OFF|ON

Command	:TRIG[:SEQ][:STAR]:ADV:HWD[?]
Long	:TRIGger[:SEQuence][:STARt]:ADVance:HWDisable[?]
Parameters	0 1 OFF ON
Parameter Suffix	None
Description	Set or query the hardware input disable state for the advancement function. When the hardware input is disabled, an advancement event can only be generated using the :TRIGger[:SEQuence][:STARt]:ADVance[:IMMediate] command. When the hardware input is enabled, an advancement event can be generated by command or by a signal present at the trigger or event input.
Example	<p>Command</p> <pre>:TRIG:ADV:HWD 0</pre> <p>Query</p> <pre>:TRIG:ADV:HWD?</pre>

5.8 TRIGger – Event/Trigger Input

5.8.1 :TRIGger[:SEQuence][:STARt]:SOURce:ADVance[?] TRIGger|EVENT|INTernal

Command	:TRIG[:SEQ][:STAR]:SOUR:ADV[?]
Long	:TRIGger[:SEQuence][:STARt]:SOURce:ADVance[?]
Parameters	TRIGger EVENT INTernal
Parameter Suffix	None
Description	Set or query the source for the advancement event. <ul style="list-style-type: none"> • TRIGger - trigger input • EVENT - event input • INTernal - internal trigger generator
Example	Command :TRIG:SOUR:ADV TRIG
	Query :TRIG:SOUR:ADV?

5.8.2 :TRIGger[:SEQuence][:STARt]:ENABle[:IMMediate]

Command	:TRIG[:SEQ][:STAR]:ENAB
Long	:TRIGger[:SEQuence][:STARt]:ENABle
Parameters	None
Parameter Suffix	None
Description	Send the enable event to a channel.
Example	Command :TRIG:ENAB

5.8.3 :TRIGger[:SEQuence][:STARt]:BEGin[:IMMediate]

Command	:TRIG[:SEQ][:STAR]:BEG[:IMM]
Long	:TRIGger[:SEQuence][:STARt]:BEGin[:IMMediate]
Parameters	None
Parameter Suffix	None
Description	Send the start/begin event to all channels of the multi-module group.
Example	Command :TRIG:BEG

5.8.4 TRIGger[:SEQuence][:STARt]:BEGin:GATE[:STATe][?] OFF|ON|0|1

Command	:TRIG[:SEQ] [:STAR] :BEG:GATE [?]
Long	:TRIGger [:SEQuence] [:STARt] :BEGin:GATE [?]
Parameters	OFF ON 0 1
Parameter Suffix	None
Description	In gated mode send a “gate open” (ON 1) or “gate close” (OFF 0) to a channel.
Example	Command :TRIG:BEG:GATE ON
	Query :TRIG:BEG:GATE?

5.8.5 :TRIGger[:SEQuence][:STARt]:ADVance[:IMMediate]

Command	:TRIG[:SEQ] [:STAR] :ADV
Long	:TRIGger [:SEQuence] [:STARt] :ADVance
Parameters	None
Parameter Suffix	None
Description	Send the advancement event to a channel.
Example	Command :TRIG:ADV

5.9 INSTRument Subsystem

5.9.1 :INSTRument:SLOT[:NUMBer]?

Command	:INST:SLOT[:NUMB]?
Long	:INSTRument:SLOT[:NUMBer]?
Parameters	None
Parameter Suffix	None
Description	Query the instrument's slot number in its AXIe frame.
Example	Query :INST:SLOT?

5.9.2 Multi-module configuration commands

These commands and queries are used to identify reachable M8195A modules and to define a multi-module group consisting of up to four slave modules.

5.9.2.1 :INSTRument:MDIScover?

Command	:INST:MDIS?
Long	:INSTRument:MDIScover?
Parameters	None
Parameter Suffix	None
Description	This query returns a comma-separated list of VISA resource strings of all M8195A modules known by the VISA Resource Manager.
Example	Query :INST:MDIS?

5.9.2.2 :INSTRument:IDENtify <visa_resource_string>

Command	:INST:IDEN
Long	:INSTRument:IDENtify
Parameters	<visa_resource_string>
Parameter Suffix	None
Description	This command toggles the green "Access" LED of the M8195 module with the passed VISA resource string for 10 seconds. This allows easy identification of one module in a setup consisting of multiple AXI frames and multiple modules.
Example	Command :INST:IDEN "TCPIP0::localhost::hislip0::INSTR"

5.9.2.3 :INSTrument: SLAVe:LIST?

Command	:INST:SLAV:LIST?
Long	:INSTrument:SLAVe:LIST?
Parameters	None
Parameter Suffix	None
Description	This query returns a comma-separated list of VISA resource strings of all M8195A slave modules that belong to the multi-module group.
Example	Query :INST:SLAV:LIST?

5.9.2.4 :INSTrument:MMODule:CONFig[?] 0|1|OFF|ON

Command	:INST:MMOD:CONF[?]
Long	:INSTrument:MMODule:CONFig[?]
Parameters	0 1 OFF ON
Parameter Suffix	None
Description	The command form enables (1 ON) or disables (0 OFF) the multi-module configuration mode for the complete multi-module group. The command forms of the following SCPIs for slave selection are only available in multi-module configuration mode. When the multi-module configuration mode is disabled, the modifications become active. The query form returns the state of the multi-module configuration mode.
Example	Command :INST:MMOD:CONF ON Query :INST:MMOD:CONF?

5.9.2.5 :INSTrument:SLAVe:ADD < visa_resource_string >

Command	:INST:SLAV:ADD
Long	:INSTrument:SLAVe:ADD
Parameters	< visa_resource_string >
Parameter Suffix	None
Description	This command adds the M8195A module with the passed VISA resource string as slave to the multi-module group.
Example	Command :INST:SLAV:ADD "TCPIP0::localhost::hislip0::INSTR"

5.9.2.6 :INSTrument: SLAVe:DELeTe < visa_resource_string >

Command	:INST:SLAV:DEL
Long	:INSTrument:SLAVe:DELeTe

Parameters	< visa_resource_string >
Parameter Suffix	None
Description	This command deletes the M8195A slave module with the passed VISA resource string from the multi-module group.
Example	Command :INST:SLAV:DEL "TCPIP0::localhost::hislip0::INSTR"

5.9.2.7 :INSTrument: SLAVe:DELete:ALL

Command	:INST:SLAV:DEL:ALL
Long	:INSTrument:SLAVe:DELete:ALL
Parameters	None
Parameter Suffix	None
Description	This command deletes all M8195A slave modules from the multi-module group.
Example	Command :INST:SLAV:DEL:ALL

5.10 MMEMory Subsystem

NOTE

MMEM commands requiring <directory_name> assume the current directory if a relative path or no path is provided. If an absolute path is provided, then it is ignored.

5.10.1 :MMEMory:CATalog? [<directory_name>]

Command	:MMEM:CAT?
Long	:MMEMory:CATalog?
Parameters	None
Parameter Suffix	None
Description	<p>Query disk usage information (drive capacity, free space available) and obtain a list of files and directories in a specified directory in the following format:</p> <p><numeric_value>,<numeric_value>,{<file_entry>}</p> <p>This command returns two numeric parameters and as many strings as there are files and directories. The first parameter indicates the total amount of storage currently used in bytes. The second parameter indicates the total amount of storage available, also in bytes. The <file_entry> is a string. Each <file_entry> indicates the name, type, and size of one file in the directory list:</p> <p><file_name>,<file_type>,<file_size></p> <p>As the Windows file system has an extension that indicates file type, <file_type> is always empty. <file_size> provides the size of the file in bytes. In case of directories, <file_entry> is surrounded by square brackets and both <file_type> and <file_size> are empty.</p>
Example	<p>Query</p> <p>:MMEM:CAT?</p>

5.10.2 MMEemory:CDIRectory [<directory_name>]

Command	:MMEemory:CDIR
Long	:MMEemory:CDIRectory
Parameters	None
Parameter Suffix	None
Description	Changes the default directory for a mass memory file system. The <directory_name> parameter is a string. If no parameter is specified, the directory is set to the *RST value. At *RST, this value is set to the default user data storage area, that is defined as System.Environment.SpecialFolder.Personal e.g. C:\Users\Name\Documents MMEemory:CDIRectory? – Query returns full path of the default directory.
Example	Command :MMEemory:CDIR "C:\Users\Name\Documents" Query :MMEemory:CDIR?

5.10.3 :MMEemory:COPY <string>,<string>[,<string>,<string>]

Command	:MMEemory:COPY
Long	:MMEemory:COPY
Parameters	<string>,<string>
Parameter Suffix	None
Description	Copies an existing file to a new file or an existing directory to a new directory. Two forms of parameters are allowed. The first form has two parameters. In this form, the first parameter specifies the source, and the second parameter specifies the destination. The second form has four parameters. In this form, the first and third parameters specify the file names. The second and fourth parameters specify the directories. The first pair of parameters specifies the source. The second pair specifies the destination. An error is generated if the source doesn't exist or the destination file already exists.
Example	Command :MMEemory:COPY "C:\data.txt", "C:\data_new.txt"

5.10.4 :MMEMory:DELeTe <file_name>[,<directory_name>]

Command	:MMEM:DEL
Long	:MMEMory:DELeTe
Parameters	<file_name>
Parameter Suffix	None
Description	Removes a file from the specified directory. The <file_name> parameter specifies the file to be removed.
Example	Command :MMEM:DEL "C:\data.txt"

5.10.5 :MMEMory:DATA <file_name>, <data>

Command	:MMEM:DATA
Long	:MMEMory:DATA
Parameters	<file_name>, <data>
Parameter Suffix	None
Description	The command form is MMEMory:DATA <file_name>, <data>. It loads <data> into the file <file_name>. <data> is in 488.2 block format. <file_name> is string data.
Example	Command :MMEM:DATA "C:\data.txt", #14test

5.10.6 :MMEMory:DATA? <file_name>

Command	:MMEM:DATA?
Long	:MMEMory:DATA?
Parameters	<file_name>
Parameter Suffix	None
Description	The query form is MMEMory:DATA? <file_name> with the response being the associated <data> in block format.
Example	Query :MMEM:DATA? "C:\data.txt"

5.10.7 :MMEMory:MDIRectory <directory_name>

Command	:MMEM:MDIR
Long	:MMEMory:MDIRectory
Parameters	<directory_name>
Parameter Suffix	None
Description	Creates a new directory. The <directory_name> parameter specifies the name to be created.
Example	Command :MMEM:MDIR "C:\data_dir"

5.10.8 :MMEMory:MOVE <string>,<string>[,<string>,<string>]

Command	:MMEM:MOVE
Long	:MMEMory:MOVE
Parameters	<string>,<string>[,<string>,<string>]
Parameter Suffix	None
Description	Moves an existing file to a new file or an existing directory to a new directory. Two forms of parameters are allowed. The first form has two parameters. In this form, the first parameter specifies the source, and the second parameter specifies the destination. The second form has four parameters. In this form, the first and third parameters specify the file names. The second and fourth parameters specify the directories. The first pair of parameters specifies the source. The second pair specifies the destination. An error is generated if the source doesn't exist or the destination file already exists.
Example	Command :MMEM:MDIR "C:\data_dir","C:\newdata_dir"

5.10.9 :MMEMory:RDIRectory <directory_name>

Command	:MMEM:RDIR
Long	:MMEMory:RDIRectory
Parameters	<directory_name >
Parameter Suffix	None
Description	Removes a directory. The <directory_name> parameter specifies the directory name to be removed. All files and directories under the specified directory are also removed.
Example	Command :MMEM:RDIR "C:\newdata_dir"

5.10.10 :MMEMory:LOAD:CState <file_name>

Command	:MMEM:LOAD:CST
Long	:MMEMory:LOAD:CState
Parameters	<file_name >
Parameter Suffix	None
Description	Current SState of instrument is loaded from a file.
Example	Command :MMEM:LOAD:CST "C:\data.txt"

5.10.11 :MMEMory:STORe:CState <file_name>

Command	:MMEM:STOR:CST
Long	:MMEMory:STORe:CState
Parameters	<file_name >
Parameter Suffix	None
Description	Current SState of instrument is stored to a file.
Example	Command :MMEM:STOR:CST "C:\data.txt"

5.11 OUTPut Subsystem

5.11.1 :OUTPut: ROSCillator:SOURce[?] INTernal|EXTernal|SCLK1|SCLK2

Command	:OUTP:ROSC:SOUR[?]
Long	:OUTPut:ROSCillator:SOURce[?]
Parameters	INTernal EXTernal SCLK1 SCLK2
Parameter Suffix	None
Description	Select which signal source is routed to the reference clock output: <ul style="list-style-type: none"> • INTernal: the module internal reference oscillator • EXTernal: the external reference clock from REF CLK IN with two variable dividers • SCLK1: DAC sample clock with variable divider and variable delay • SCLK2: DAC sample clock with fixed divider
Example	<p>Command</p> <pre>:OUTP:ROSC:SOUR INT</pre> <p>Query</p> <pre>:OUTP:ROSC:SOUR?</pre>

5.11.2 :OUTPut: ROSCillator:SCD[?] <sample_clock_divider>

Command	:OUTP:ROSC:SCD[?]
Long	:OUTPut:ROSCillator:SCD[?]
Parameters	sample_clock_divider
Parameter Suffix	None
Description	Set or query the divider of the DAC sample clock signal routed to the reference clock output.
Example	<p>Command</p> <pre>:OUTP:ROSC:SCD 1</pre> <p>Query</p> <pre>:OUTP:ROSC:SCD?</pre>

5.11.3 :OUTPut: ROscillator:RCD1[?] <reference_clock_divider1>

Command	:OUTP:ROSC:RCD1 [?]
Long	:OUTPut:ROScillator:RCD1 [?]
Parameters	reference_clock_divider1
Parameter Suffix	None
Description	Set or query the first divider of the reference clock signal routed to the reference clock output.
Example	Command :OUTP:ROSC:RCD1 2
	Query :OUTP:ROSC:RCD1?

5.11.4 :OUTPut: ROscillator:RCD2[?] <reference_clock_divider2>

Command	:OUTP:ROSC:RCD2 [?]
Long	:OUTPut:ROScillator:RCD2 [?]
Parameters	reference_clock_divider2
Parameter Suffix	None
Description	Set or query the second divider of the external reference clock signal routed to the reference clock output.
Example	Command :OUTP:ROSC:RCD2 1
	Query :OUTP:ROSC:RCD2?

5.12 Sampling Frequency Commands

5.12.1 [:SOURce]:FREQuency:RASTer[?] <frequency>|MINimum|MAXimum

Command	[:SOUR] :FREQ:RAST [?]
Long	[:SOURce] :FREQuency:RASTer [?]
Parameters	<frequency> MINimum MAXimum
Parameter Suffix	None
Description	Set or query the sample frequency of the output DAC.
Example	Command :FREQ:RAST MIN
	Query :FREQ:RAST?

5.13 Reference Oscillator Commands

5.13.1 [:SOURce]:ROSCillator:SOURce[?] EXTernal|AXI|INTernal

Command	<code>[:SOUR] :ROSC :SOUR [?]</code>
Long	<code>[:SOURce] :ROSCillator :SOURce [?]</code>
Parameters	EXTernal AXI INTernal
Parameter Suffix	None
Description	Set or query the reference clock source. <ul style="list-style-type: none"> • EXTernal: reference is taken from REF CLK IN. • AXI: reference is taken from AXI backplane. • INTernal: reference is taken from module internal reference oscillator.
Example	<p>Command</p> <pre>:ROSC:SOUR AXI</pre> <p>Query</p> <pre>:ROSC:SOUR?</pre>

5.13.2 [:SOURce]:ROSCillator:SOURce:CHECK? EXTernal|AXI|INTernal

Command	<code>[:SOUR] :ROSC :SOUR :CHEC ?</code>
Long	<code>[:SOURce] :ROSCillator :SOURce :CHECK ?</code>
Parameters	EXTernal AXI INTernal
Parameter Suffix	None
Description	Check if a reference clock source is available. Returns 1 if it is available and 0 if not.
Example	<p>Query</p> <pre>:ROSC:SOUR:CHEC? AXI</pre>

5.13.3 [:SOURce]:ROSCillator:FREQuency[?] <frequency>|MINimum|MAXimum

Command	<code>[:SOUR] :ROSC :FREQ [?]</code>
Long	<code>[:SOURce] :ROSCillator :FREQuency [?]</code>
Parameters	<frequency> MINimum MAXimum
Parameter Suffix	None
Description	Set or query the expected reference clock frequency, if the external reference clock source is selected.
Example	<p>Command</p> <pre>:ROSC:FREQ MIN</pre> <p>Query</p> <pre>:ROSC:FREQ?</pre>

5.13.4 [:SOURce]:ROSCillator:RANGe[?] RANG1| RANG2

Command	[:SOUR] :ROSC:RANG [?]
Long	[:SOURce] :ROSCillator:RANGe [?]
Parameters	RANG1 RANG2
Parameter Suffix	None
Description	Set or query the reference clock frequency range, if the external reference clock source is selected. RANG1: 10...300 MHz RANG2: 210MHz...17GHz
Example	Command :ROSC:RANG RANG1 Query :ROSC:RANG?

5.13.5 [:SOURce]:ROSCillator:RNG1|RNG2:FREQuency[?]
<frequency>|MINimum|MAXimum

Command	[:SOUR] :ROSC:RNG1 RNG2:FREQ [?]
Long	[:SOURce] :ROSCillator:RNG1 RNG2:FREQuency [?]
Parameters	<frequency> MINimum MAXimum
Parameter Suffix	None
Description	Set or query the reference clock frequency for a specific reference clock range. Current range remains unchanged. RNG1: 10...300 MHz RNG2: 210MHz...17GHz
Example	Command :ROSC:RNG1:FREQ MIN Query :ROSC:RNG1FREQ?

5.14 STABLE Subsystem

5.14.1 [:SOURCE]:STABLE:DYNAMIC:SELECT <sequence_table_index>

Command	:STAB:DYN:SEL
Long	:STABLE:DYNAMIC:SELECT
Parameters	<sequence_table_index>
Parameter Suffix	None
Description	When the dynamic mode for segments or sequences is active on the connected M8195 modules, set the sequence table entry to be executed next.
Example	Command :STAB:DYN:SEL 0

5.15 TEST Subsystem

5.15.1 :TEST:PON?

Command	:TEST:PON?
Long	:TEST:PON?
Parameters	None
Parameter Suffix	None
Description	Return the results of the power on self-tests.
Example	Query :TEST:PON?

5.15.2 :TEST:TST?

Command	:TEST:TST?
Long	:TEST:TST?
Parameters	None
Parameter Suffix	None
Description	Same as *TST?, but the actual test messages are returned.
Example	Query :TEST:TST?

NOTE

Currently same as :TEST:PON?

6 Characteristics

- 6.1 Performance Specification / 100
- 6.2 General / 100
- 6.3 Maintenance / 101

6.1 Performance Specification

The performance specification can be found in the data sheet available at:

<http://www.keysight.com/find/M8197A>

6.2 General

Table 15 Characteristics

Characteristics	Description
Power consumption	60 W (nom)
Operating temperature	0 °C to 40 °C
Storage temperature	-40 °C to 70 °C
Operating humidity	5 % to 80 % relative humidity, non-condensing
Operating altitude	up to 2000 m
Safety designed to	IEC61010-1, UL61010, CSA22.2 61010.1 tested
EMC	tested to IEC61326-1
Interface to controlling PC	PCIe (see AXIe chassis specification)
Form factor	1-slot AXIe module
Dimensions (W x H x D)	351 mm x 29 mm x 310 mm
Weight	2.7 kg
Warm-up time	30 minutes
Calibration interval	2 years recommended
Cooling Requirements	When operating the M8197A, choose a location that provides at least 80 mm of clearance at rear, and at least 30 mm of clearance at each side for the AXIe chassis.

WARNING

The instrument is not designed for outdoor use. Do not expose the instrument to rain or other excessive moisture. Protect the instrument from humidity and temperature changes, which could cause condensation within the instrument.

Do not operate the instrument in the presence of flammable gases, fumes or powders. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

6.3 Maintenance

6.3.1 ESD Protection



CAUTION

All the connectors are very sensitive to electrostatic discharge (ESD). When you connect a device or cable that is not fully discharged to these connectors, you risk damage to the instrument and expensive instrument repairs.

CAUTION

Electrostatic discharge (ESD) can damage the circuits of the M8197A. Avoid applying static discharges to the front-panel connectors. Before connecting any coaxial cable to the connectors, momentarily short the center and outer conductors of the cable together. Avoid touching the front-panel connectors without first touching the frame of the instrument. Be sure the instrument and all connected devices (DUT, etc.) are properly earth-grounded (to a common ground) to prevent buildup of static charge and electrical over-stress.

6.3.2 Power and Ventilation Requirements

For power and ventilation requirements, refer to:

- <http://www.Keysight.com/find/M9505A> for 5-slot chassis related documentation.
- <http://www.Keysight.com/find/M9502A> for 2-slot chassis related documentation.

6.3.3 Thermal Protection

Overheating Detection The instrument monitors its internal temperature. If the temperature exceeds approximately 80 °C the power supply is switched off. The instrument will not turn on automatically if the temperature is decreasing again.

Fan Failure If a fan is broken or prevented from operating by a blockage, the temperature will increase. When the temperature exceeds approximately 80 °C the overheating detection switches off the instrument for safety reasons. To ensure reliable operation, it is recommended to send instruments with broken or defective fans immediately to Keysight Service for repair.

6.3.4 Cleaning Recommendation

WARNING

To prevent electrical shock, disconnect the instrument from mains before cleaning. Use a dry cloth or one slightly dampened with water to clean external case parts. Do not attempt to clean internally.



This information is subject to change without notice.
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